Revised 8/4/98

CORRES. CONTROL
OUTGOING LTR NO.

DOE ORDER #

-RF-00170

DIST.	LT	ENC
BACON, R.F.		
BENSUSSEN, S.J.		
BORMOLINI, A.M.		
BOYTER, N.C.		
BRAILSFORD, M.D.		
BRYNER, C.J.		
BURDGE, L.		
CARD, R.G.		
BURDGE, L.		
COLES, GARY		
COSGROVE, M.M.		
CRAWFORD, A.C.		
CROWE, STEVE		
DORR, K.		
ERVIN, PATRICK		
FERRERA,D.W.		
FERRERA, KEN		
FULTON, J.C.		
GEIS, ART		
GILMARTIN, TOM		
HARDING, W.A.		
HEDAHL, TIM	X	
HUGHES, F.		
HUTCHINS, NED		
MARTINEZ, L.A.		
MATHIS, BRIAN	X	
PARKER, ALAN	X	
PIZZUTO, VIC		
POLSTON, S.		
RODGERS, ALAN		
SNYDER, DUKE		
SPEARS, M.		
STEVENS, JEFF	X	
TUOR, N.R.		
ORHEIS, GARY		
KER, RANDY		
WIEMELT, KAREN		
WIRTH, T.J.		
WITHERSPOON, M.		
Arcmore, J.	X	
Brooks, J.	X	
Hickman, M.	X	
COR. CONTROL	X	X
ADMN. RECORD	X	X
TRAFFIC		
PATS/T130G		
CLASSIFICATION:		
UCNI		
UNCLASSIFIED	X	X
CONFIDENTIAL		
SECRET		

AUTHORIZED CLASSIFIER SIGNATURE (CWO)

1/14/99
Date

IN REPLY TO RFP CC NO:

ACTION ITEM STATUS

☐ PARTIAL/OPEN

☐ CLOSED

LTR APPROVALS:

ORIG & TYPIST INITIALS
J[illegible]tld

Revised 8/4/1998

KAISER•HILL
COMPANY

January 14, 1999 99-RF-00170

Henry F. Dalton
Asst. Manager Material Stabilization & Disposition
DOE, RFFO

TRANSMITTAL OF THE CLOSEOUT RADIOLOGICAL SURVEY PLAN FOR THE 77[illegible]
CLUSTER - BWM-002-99

Enclosed are three copies of the Closeout Radiological Survey Plan for the 779 Cluster for Rocky Flats Field Office (RFFO) review. The document was written utilizing the consultative process defined in Rocky Flats Cleanup Agreement (RFCA), and incorporates disposition of all final review comments from RFFO, Colorado Department of Public Health and Environment (CDPHE) and Environmental Protection Agency (EPA). The plan has been reviewed and approved by Kaiser-Hill Company, L.L.C. (K-H).

Implementation of the plan, which defines the methods for collecting, analyzing and documenting data is underway. The plan will be adhered to for Building 729, Filter Plenum facility, scheduled for demolition in March/April 1999, followed concurrently with the remainder of the Building 779 Cluster.

If you have any questions, please contact myself on extension 3432 or John Whiting on extension 7592.

Brian W. Mathis
Division Manager
D & D Projects

JWW:tld

Original and 1 cc – Henry F. Dalton

Enclosure:
As Stated

cc:
Dave J. Nickless, John J. Rampe

Kaiser-Hill Company, L.L.C.
Courier Address: Rocky Flats Environmental Technology Site, State Hwy. 93 and Cactus, Rocky Flats, CO 80007 • 303.96[illegible]
Mailing Address: P.O. Box 464, Golden, Colorado 80402-0464

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JOHN WHITING	D&D/PROJECTS	J.W.	1/14/99
Jim Archibald	D&D		1/14/99
	1		

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John Whiting
Originator Name

Contractor Manager(s)

Kaiser-Hill Program Manager(s)

Brian Mathis
Kaiser-Hill Division Manager

DOCUMENT SUBJECT:

TRANSMITTAL OF THE CLOSEOUT RADIOLOGICAL SURVEY PLAN FOR 779 CLUSTER

BWM-002-99 99-RF-00170

Discussion and/or Comments:

LD 14-99

Rocky Mountain Remediation Services

779 Closure Project

RF/RMRS-97-123.UN

Closeout Radiological Survey Plan

For The 779 Cluster

Rocky Mountain Remediation Services, L.L.C.

Revision 1

DECEMBER, 98

REVIEWED FOR CLASSIFICATION/UCNI
By J. H. NEWLAN
Date 12/10/98

ADMIN RECORD

779 CLUSTER DECOMMISSIONING PROJECT
CLOSEOUT RADIOLOGICAL SURVEY PLAN

REVISION 1

DECEMBER, 98

This Closeout Radiological Survey Plan was prepared by:

Michael Grube, Final Survey Radiological Engineer (GTS DURATEK) — Date: 12/4/98

This Closeout Radiological Survey Plan has been reviewed and approved by:

Mark Hickman, Integration Manager, B779 (RMRS) — Date: 12-7-98

Ken Harrawood, Radiological Safety Manager, B779 (RMRS) — Date: 12/8/98

Bates Estabrooks, Radiological Engineering Field Services Manager (RMRS) — Date: 12/8/98

Jeff Barroso, Radiological Engineering Support Services Manager (RMRS) — Date: 12/8/98

Kelly Trice, Director, B779 (RMRS) — Date: 12/7/98

Brian Mathis, Manager D&D Projects (K-H) — Date: 12-8-98

CLOSEOUT RADIOLOGICAL SURVEY PLAN

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APPENDICES

ATTACHMENTS

Memorandum – "Application of Surface Contamination Guidelines From Department of Energy Order 5400.5 – WAH-064-98, 3/10/98" from Wynn A. Harding, Vice President Safety Systems & Engineering Kaiser-Hill Company, L.L.C. to David C. Lowe, Assistant Manager for Engineering, DOE RFFO.

Memorandum — "Application of Surface Contamination Guidelines From Department of Energy Order 5400.5, 4/23/98" from David C. Lowe, Assistant Manager for Engineering, DOE RFFO to Wynn A. Harding, Vice President Safety Systems & Engineering Kaiser-Hill Company, L.L.C.

DEFINITIONS

$DCGL_W$ - Derived Concentration Guideline Level - Contamination limit based on the assumption that the concentration of residual activity is evenly distributed over a large area.

$DCGL_{EMC}$ - Derived Concentration Guideline Level - Contamination limit based on the assumption that the concentration of residual activity is distributed as small-elevated areas within a larger area.

Impacted Class 1 Areas - Areas that have potential contamination (based on building operating history) or known contamination (based on past or preliminary characterization survey data). This would normally include areas where radioactive materials were used and stored and where records indicate spills or other unusual occurrences could have resulted in the spread of contamination.

Impacted Class 2 Areas - Areas that have or had a potential for radioactive contamination or known contamination, but are not expected to exceed the applicable contamination limits.

Impacted Class 3 Areas - All areas not classified as Impacted Class 1, Impacted Class 2 or Non-impacted. These areas are not expected to contain residual contamination above the applicable limits, based on knowledge of building history and previous survey information. However, insufficient documentation is present to exclude the area from survey requirements.

Local Area Background - Background survey instrument readings taken at specific locations within a survey unit in order to determine actual contamination values in a more precise manner.

Non-Impacted Areas - All areas not classified as Impacted Class 1, Impacted Class 2 or Impacted Class 3. These areas are areas where there is no reasonable potential for residual contamination, based on knowledge of building history and/or previous survey information. Sufficient information is present to be assured that no residual contamination is present above the applicable contamination limits.

Measurement Location - A survey location where the typical set of total surface contamination and removable contamination measurements are obtained

Minimum Detectable Activity - The minimum amount of activity that can be statistically detected above background with a 95% probability and with a maximum of 5% probability of falsely interpreting sample activity as activity due to background

Survey Area - The most general category, comprised of surfaces to be further defined as one or more survey units, the bounds of which are defined by existing physical features such as walls, columns, beams etc.

Survey Unit - A contiguous area with similar characteristics and contamination potential. Survey units are established to facilitate the process and aid in the statistical evaluation of the survey data

Survey Design - The process of determining the type, location, number and density of radiological measurements to be taken for final survey

Survey Package - A collection of information in a standardized format for controlling and documenting field measurements taken for final survey. A survey package is prepared for each Survey Unit. The survey package typically includes the survey instructions, survey data sheets and grid maps.

Survey Point - A smaller subdivision within an area designated as a survey location where measurements are obtained. This area generally refers to the area covered by a detector probe or 100 cm^2 when a smear is obtained.

Survey Instructions - Written instructions which specify the type and number of measurements to be taken in a survey unit. Each survey package shall include survey instructions.

CLOSEOUT RADIOLOGICAL SURVEY PLAN FOR THE 779 CLUSTER

PREFACE

RADIATION SURVEY AND SITE INVESTIGATION PROCESS

In accordance with the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), the Radiation Survey and Site Investigation (RSSI) process is developed as an all encompassing final survey program. This RSSI includes the following six (6) principal steps:

1) Site Identification
2) Historical Site Assessment
3) Scoping Surveys
4) Characterization Surveys
5) Remedial Action Support Surveys
6) Final Status Surveys.

The Site Identification has already occurred at RFETS. The Historical Site Assessment is performed to collect existing information concerning the site and its surroundings. This information includes:

1) Identifying potential sources of contamination
2) Determining whether or not the site poses a threat to human health and the environment
3) Differentiates impacted and non-impacted areas
4) Provides input to scoping and characterization survey designs
5) Provides an assessment of the likelihood of contaminant migration
6) Identifies additional potential radiation sites related to the site being investigated.

RSSI steps 3, 4, 5 and 6 are included in the Data Life Cycle (DLC) which incorporates the following four phases:

1) Planning surveys
2) Implementation of the surveys
3) Assessing final survey data
4) Evaluating the final survey data to ensure the survey demonstrates regulatory compliance.

The Closeout Radiological Survey Plan (CRSP) is an integral part of the DLC. A stand-alone document, the 779 Cluster Survey Breakdown Structure is being prepared to delineate survey units and radiological classifications for each survey unit. Additional information that will be provided in the Survey Breakdown Structure will be the survey area, survey unit description, justification for classifications, and building maps showing the survey units. This document will be revised periodically as survey units change based on reclassification or combining of units based on modifications such as wall removal. This document will undergo an approval process by project management and radiological engineering. The final survey instructions are another part of the DLC and will be used to delineate survey requirements not incorporated into the CRSP. These survey instructions will provide instrument requirements, survey locations and quantities, background requirements, survey maps, etc. This information will be available to the Lead Regulatory Agency (LRA) for review.

Because of the nature of the D & D process at RFETS, and the fact that the beginning phase of the DLC is being developed in the early stages of the decommissioning of the Building 779 Cluster, the preliminary CRSP should be considered a "living document". It will be subject to periodic revisions based on newly discovered information. If the document is revised, all current reviewing parties will be included in the review process. This will ensure input from all interesting parties is considered and incorporated as required. Potential changes to this CRSP would include, but not be limited to the following:

- Additional requirements for the survey of nuclides not presently considered contaminants of concern detected as a result of additional characterization surveys. (For example, beta characterization surveys to be performed after room strip-out could indicate the presence of beta contamination above unrestricted release limits, in which case an evaluation would be performed to identify the nuclide. If the nuclide does not emit alpha particles in conjunction with beta particles emitted, the CRSP would have to be revised to include beta survey requirements.)

- Additional regulatory input provided to RFETS (For example, Area Factors would be helpful to assist in the determination of a different $DCGL_{EMC}$ and to determine if instrument scans are adequate.)

MARSSIM COMPLIANCE

The Multi-Agency Radiation Survey and Site Investigation Manual, 12/97(MARSSIM) will be utilized for specific guidance in the development of this CRSP and for the performance of the closeout of the 779 Cluster. Specific sections of MARSSIM will not be utilized for guidance for the following reasons:

- Automated Surface Contamination Monitors (SCMs) may be utilized in addition to portable instrumentation for the detection of total surface contamination, provided the instrument's MDAs are no greater than 50% of the associated RFETS unrestricted release criteria. MARSSIM statistical calculations will not be performed on data collected with SCMs and it's associated survey information management system because approximately 400 measurements of total surface contamination per m^2 are recorded. This sample density far exceeds the sample requirements that would be required by MARSSIM. The reports generated by the Survey Information Management System (SIMS) include the following statistical parameters: maximum, minimum, mean and standard deviation for each m^2 surveyed. The statistics for this size of a data set performed on each m^2 are far superior to the statistics performed on a limited data set, which would typically be required by MARSSIM. In addition, because of the 100% survey coverage, the use of these SCMs fulfills the requirement for scan surveys as well.

- Current RFETS release criteria is not dose based, but instead is derived from DOE Order 5400.5. Information required to develop AREA FACTORS has not been developed for RFETS. Therefore, average and maximum total contamination values stated in DOE Order 5400.5 will be used as the $DCGL_W$ and the $DCGL_{EMC}$ respectively instead of calculating these parameters in accordance with Section 5.5.2.4 of MARSSIM. In addition, 5400.5 requires that the average of contamination values for total contamination cannot exceed 100 dpm/100 cm^2 when averaged over 1 m^2. This DOE requirement will be adhered to instead of using the approach recommended by MARSSIM in using the Sign Test for statistical data evaluations. The application of this MARSSIM statistical test would allow a certain percentage of survey values to exceed the DOE Order 5400.5 average. An elevated measurement evaluation will be performed in the event measurements exceed the applicable $DCGL_W$ and the applicable $DCGL_{EMC}$.

- Background reference measurements will not be obtained for paint/surface media samples or fixed measurements because the alpha radiation emitted from the contaminants of concern are considered present in such low levels that they are considered insignificant. However, local area background subtract will be performed for total alpha measurements. The major component of this local area alpha background is instrument noise, but may include to a lesser level, alpha from radon and or Natural Occurring Radioactive Material (NORM). Background beta reference measurements will not be used for characterization surveys performed using the SCMs because the background is determined through statistical analysis of the survey data.

The contents of this CRSP fulfill the requirement for a Quality Assurance Program Plan (QAPP) as discussed in Section 9.2 in MARSSIM. Specific Quality Assurance and Quality Control information is contained in Section 16.0.

1.0 PURPOSE

The primary purpose of this Radiological Survey Plan is to demonstrate compliance with the 779 Decommissioning Plan (DOP, Section 5.1) and Rocky Flats Cleanup Agreement's (RFCA) cleanup criteria. The RFCA identifies the Colorado Department of Public Health and Environment (CDPHE) as the Lead Regulatory Agency (LRA) that will work with the Department of Energy (DOE) in ensuring the facilities meet the identified cleanup levels. Therefore, the LRA is responsible for monitoring the cleanup activities at the Rocky Flats Environmental Technology Site (RFETS). To ensure adequate stakeholder input, this document has been prepared, reviewed, and approved in coordination with the LRA.

In addition, the CRSP defines the methods for collecting, analyzing, and documenting data. The survey will include the floors, ceilings, interior and exterior walls, accessible surfaces of the roof, and fixed equipment. Those areas that contain radioactive material above the unrestricted release criteria will be decontaminated to meet the release criteria and released, or managed as radioactive material.

2.0 DESCRIPTION

2.1 FACILITY HISTORY OF BUILDING 779

Building 779 was originally constructed in 1965. The building was expanded in 1968 and again in 1973. The additions are referred to as Building 779-A and Building 779-B. Since all three additions are physically connected, and share resources and mission, any reference to Building 779 should be understood to include all three additions.

The first addition to Building 779 (Annex A) was completed in 1968. The addition added office space, laboratory area dedicated to pyrochemical technology, hydride operations, physical metallography, joining technology, and the necessary heating, ventilation, and air conditioning (HVAC) equipment to supplement the existing HVAC system. The 1968 addition is a single story facility attached to the north end of Building 779.

The second addition to Building 779 (Annex B) was made in 1973. The addition is a two-story facility added to the south side of the original Building 779. Although both additions are architecturally and structurally different from the original Building 779, they are functionally tied to the original building.

Building 779 was used as a Nuclear Weapons Research & Development Center. Building 779 contained process equipment, which could mimic some of the production facilities' mission, and laboratory equipment to conduct material and environmental testing.

2.2 BUILDING 779 SUPPORT FACILITIES

The Building 779 Support facilities are described as follows (See the map on the following page for the building layout):

Along with the two building additions, two filter plenum buildings were constructed after Building 779 was completed. Building 729 was constructed in 1971, and contains a filter plenum and an emergency electrical power generator. Building 729 is connected to Building 779 via a second story bridge and supports Annex B. Building 729 has dimensions of 72 feet x 38 feet and is located immediately south of Building 779. Building 782 was constructed in 1973, and serves as the second filter plenum for Building 779. Building 782 covers 60 feet x 99 feet and is located east of Building 779. The emergency generator for Building 782 is located in Building 727, located north of Building 782.

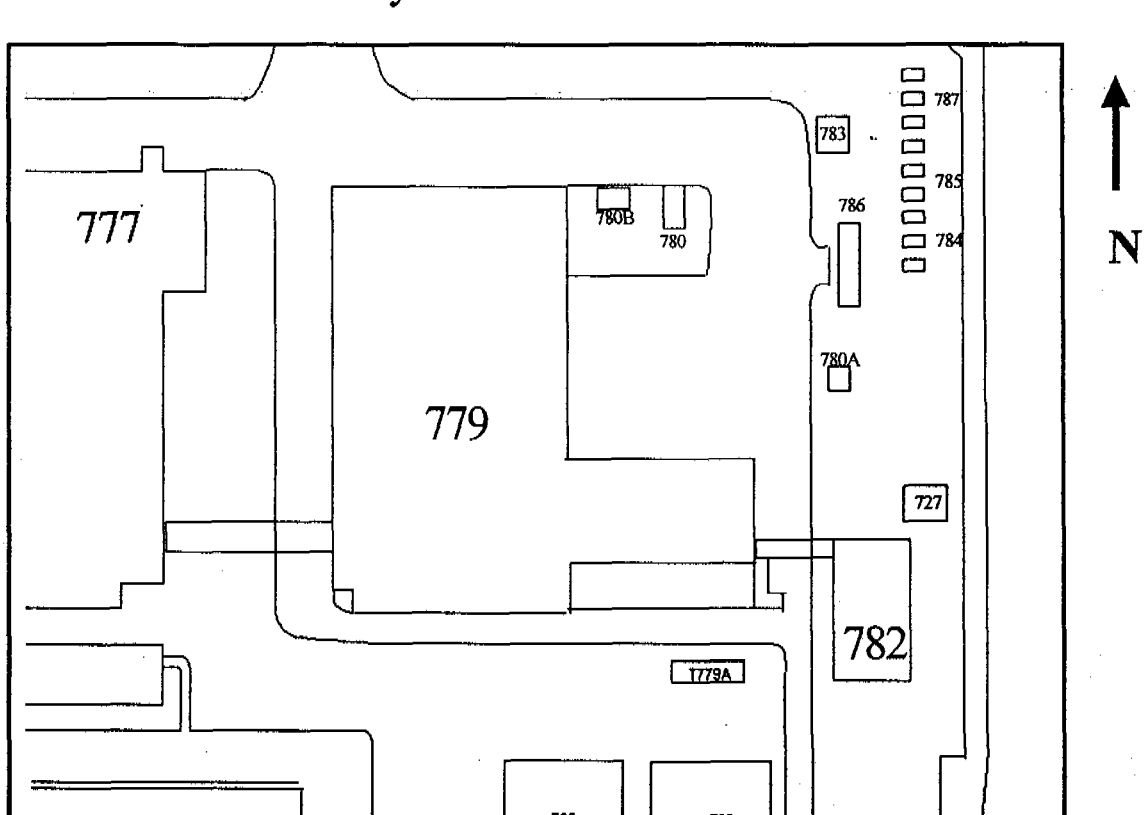
The following buildings are located adjacent to one other, northeast of Building 779, and north of Building 727:

Building 783 - Cooling Tower Pump House

Buildings 780, 780A and 780B

(The cooling towers will not be final surveyed, but will be released under the Radiological Engineering Release Evaluation Process.)

779 Cluster Layout Plan



3.0 SCOPE

The surveys of the buildings will include all floors, interior wall and ceiling surfaces, and accessible surfaces of exterior walls, roofs, and fixed equipment.

The scope of the 779 Cluster Decommissioning Project Closeout Radiological Survey, as delineated in the Decommissioning Operations Plan (DOP) and the Rocky Flats Cleanup Agreement (RFCA), and as defined in this document is to:

- Provide a description of the graded approach used in determining the intensity of sampling and survey data gathering which must be obtained to make the determination that the 779 Cluster meets the DOE release criteria delineated in RFCA.

- Develop a survey and sampling approach which, when implemented, will obtain adequate information to demonstrate that the buildings identified have no contamination levels above the release levels and may be demolished and disposed of as recycled material or sanitary land fill. In addition, this plan is designed to identify and record the location of areas that are determined to be above release levels so that appropriate actions can be taken prior to building demolition.

- State the release criteria, which will be used to free-release the buildings.

4.0 SURVEY OBJECTIVES

The survey is designed to demonstrate that radioactive contamination is not above the applicable unrestricted release criteria in the identified project buildings. The survey objectives are:

- Provide a reliable and systematic approach to evaluating survey data used to demonstrate specific release criteria is met.
- Provide the methods, which will be used in implementing a graded approach to verify decontamination efforts if required are complete, and to verify all areas surveyed, meet the unrestricted release criteria.

5.0 SITE ASSESSMENT

5.1 CONTAMINATION IDENTIFICATION AND SURVEY REQUIREMENTS

5.1.1 Historical Site Assessment

From a radiological contamination standpoint, Building 779 has been divided into three areas based on contamination potential. The areas are classified as "Contamination Areas" (CA), "Radiological Buffer Areas" (RBA), and non-contaminated areas such as offices and rest room facilities. All rooms presently in the CA and RBA will be initially classified as Impacted Class 1. See Appendix C for room/building process history.

Based on the, review of historical records, process knowledge of the identified project buildings and associated equipment/systems, and the result of radiological surveys, contamination has been identified as follows:

- Significant levels of plutonium and to a lesser extent uranium and americium contamination exist in a majority of the glove boxes, hoods, and ventilation systems in Building 779.
- Alpha contamination on floor and wall surfaces in many rooms has been fixed with paint.
- A significant number of spills of transuranic material have occurred in many of the laboratory areas.
- The potential exists for contamination to be in floor cracks as well as beneath the asbestos floor tiles.
- Numerous incidents of high airborne alpha activity have potentially contaminated many surface areas of Building 779.
- Portions of the filter plenums in Buildings 729 and 782 contain significant levels of alpha contamination. The heat chamber and first stage of Plenum 408 are designated "High Contamination Areas" (HCA). The remaining areas of both plenums are radiological buffer areas. See Appendix C for room/building process history.

5.1.2 Characterization, In-Process and Equipment/Material Release Surveys

Reconnaissance characterization surveys have been performed on approximately 90% of the B779 contamination areas to date. In addition, B729, and B782 have been extensively characterized. (Refer to Appendix C for a summary of the survey results)

In-process alpha characterization surveys will be performed during the removal of fixed equipment, and strip-out of the buildings. Total surface and removable alpha characterization surveys will be performed after the equipment has been stripped out. It is anticipated that a majority of the equipment and material will be disposed of as radioactive waste. Material and equipment designated for unrestricted release will be surveyed extensively and released in accordance with Site Procedure 1-P73-HSP-18.10, *Radioactive Material Transfer and Unrestricted Release of Property and Waste.*

In addition to alpha surveys, in order to dismiss the possibility for potential contamination from the possible use of liquid beta sources, the following beta characterization surveys will be performed after room strip-out has occurred:

As a minimum, total surface and removable beta surveys per MARSSIM statistical calculations for Class 1 areas, as well as a 100% beta scan will be performed on accessible areas of the floors and lower walls in the following areas (which were previous laboratories or source storage locations) to ensure the unrestricted release criteria are met for beta contamination:

Areas previously identified as rooms 001, 125, 126, 128, 131, 137, 139, 140, 140A, 140B, 141, 141A, 141B, 141C, 150, 152, 153, 153A, 153B, 154, 155, 156, 157, 160, 160A, 217, 218, 220, 222, 223, 224, 225, 228, 234, 234A, 234B, 235, 270, 271, and 272.

Beta removable and total characterization surveys have been performed in the glovebox and room plenums in building 729. No removable or total beta contamination was detected above MDA in either plenum. Therefore no additional beta surveys will be required in B782.

Beta removable and total characterization surveys will be performed in the glovebox and room plenums in building 782. If no removable or total beta contamination is detected above the applicable DCGL, in either plenum, then no additional beta surveys will be required in B729.

Because of the discovery of information regarding the handling of tritium contaminated metal in 3 glove boxes in room 154, removable tritium characterization surveys per MARSSIM statistical calculations for Class 1 areas, will be performed in the area previously classified as room 154.

The MDAs for instruments used to assess tritium and beta will be approximately 50% of the applicable DCGL.

The beta and tritium characterization survey measurement density will be at a minimum as determined utilizing MARSSIM statistical calculations. The following limits, which were selected, based on the most conservative strontium beta limits delineated in DOE Order 5400.5, will apply for these characterization surveys.

	Removable (dpm/100 cm^2)	**Total Beta (Average)** (dpm/100 cm^2)	**Total Beta (Maximum)** (dpm/100 cm^2)
Beta	200	1000	3000
Tritium	10,000	N/A	N/A

Materials covered with surface media, floor tiles/adhesive, cracks and crevices will be handled in accordance with one of the following, as applicable: (See Appendix D for the paint/surface media sampling protocol)

- Representative paint/surface media samples for alpha will be obtained during the characterization and in-process phases. Material will be released after final survey measurements are made (if RFETS unrestricted release criteria for samples and survey data is met).
- Cracks and crevices will be sampled and analyzed for alpha using the same methodology as surface media samples.
- Painted material/areas suspected of covering alpha contamination may be scabbled prior to being final surveyed.
- Floor tile/adhesive will be removed prior to the performance of final surveys, or the portions of tile removed and the adhesive will be sampled and analyzed as surface media for alpha.
- Roofing material will be removed prior to the performance of final surveys, or sampled and analyzed as surface media for alpha.

- Painted material/areas not scabbled or sampled will be processed as radioactive waste

Building systems will be generally surveyed as follows:

- All ventilation, exhaust, process waste systems, and vacuum systems are considered internally contaminated and will be disposed of as radioactive waste or surveyed and released in accordance with Site Procedure 1-P73-HSP-18.10, *Radioactive Material Transfer and Unrestricted Release of Property and Waste* prior to final survey.
- Pressurized gas systems will be classified as non-impacted internally, but will be surveyed on accessible external surfaces and released in accordance with Site Procedure 1-P73-HSP-18.10, *Radioactive Material Transfer and Unrestricted Release of Property and Waste* prior to final survey.
- The most recent sample of the domestic water system periodically obtained by RFETS will be evaluated to verify the system is free of internal contamination. Accessible external surfaces of domestic water system piping will be surveyed and released in accordance with Site Procedure 1-P73-HSP-18.10, *Radioactive Material Transfer and Unrestricted Release of Property and Waste* prior to final survey.
- Other miscellaneous systems will be classified and evaluated on a case-by-case basis.

5.1.3 CONTAMINANTS OF CONCERN

The following information discusses the types of radioactive material present in the 779 Cluster. The discussion includes the ratios and percentages of alpha and beta radiation emitted by the identified radioactive material.

5.1.3.1 Alpha

Weapons Grade Plutonium (WGP) - According to an analysis performed by Sandia National Laboratories (Sandia 1978), weapons grade plutonium (WGP) can be assumed to contain the following primary isotopes of concern and associated weight fractions: Pu-238 (0.03%), Pu-239 (93.9%), Pu-240 (5.7%), Pu-241 (0.3%), and Am-241 (0.02%). Pu-238, Pu-239, Pu-240 decay by alpha emission. Pu-241 undergoes radioactive decay by beta emission. The maximum energy of the beta particle is 20.81 keV and the average energy is 5.23 keV. A 20 keV beta particle has a range of approximately 0.7 mg/cm^2. This range is less than the 30-50 mg/cm^2 depth recommended for deterministic effects and less than the 2-10 mg/cm^2 depth recommended for evaluation of stochastic effects (ICRP 1991). In addition, Pu-241 beta particles are comparable to tritium in difficulty of detection using conventional survey instrumentation. Also, the Derived Air Concentration (DAC) for Pu-239 is 200 times more restrictive than Pu-241. Am-241 is a daughter product of Pu-241. Am-241 decays by alpha emission and also emits a characteristic 60 keV x-ray. In-growth of Am-241 is fairly rapid due to the short half-life of Pu-241 (13.8 years). The specific activity (Curies/gm) of WGP is driven by the mass of Pu-239 and Pu-240. Combined, they account for approximately 87% of the alpha activity. The remainder of alpha activity is due to the decay of Am-241 and Pu-238.

Highly Enriched Uranyl Nitrate (HEUN) - U-234, and U-235 decay by alpha emission. The specific activity varies with the percent enrichment. HEUN enriched to 90% U-235 show a ratio of 127.8 dpm alpha to 1.1 dpm beta. U-235 also has a characteristic 185 keV gamma emitted following decay.

Depleted Uranium (D-238) - D-238 is natural uranium which has been processed to remove U-235 (approximately 0.2% U-235 by weight remains with the D-238). D-238 consists of U-238, U-238 daughter products and U-234. U-238 decays by alpha emission and has two daughter products in secular equilibrium: Th-234 and Pa-234^m. Th-234 and Pa-234^m both decay by beta emission. The secular equilibrium status means that there are two betas given off for every one alpha from U-238. Approximately 90% of the alpha emissions are from U-238 and approximately 8.4% from U-234. The beta to alpha ratio is approximately 180 dpm beta to 100 dpm alpha.

The above ratios support justification for performing alpha only final surveys utilizing the most restrictive transuranic alpha limits.

5.1.3.2 Beta

Based on the above information and the following investigation summary, there is no reason to believe any "beta only" nuclides existed in the Building 779 Cluster with the following exceptions: sealed solid sources which are periodically leak checked, and had no recorded instances of source leaks, gaseous H-3 sources which are not expected to result in surface contamination, and H-3 contaminated plutonium metal inadvertently released to RFETS from Lawrence Livermore Labs in 1973 and processed in 3 glove boxes in room 154. (It is suspected that this H-3 is no longer present as a surface contaminant because of its natural volatility and half-life. However, as discussed previously in Section 5.1.3, characterization surveys for H-3 will be performed in room 154 to validate this assumption.)

- Process knowledge from 39 processes as reported by the Waste Stream and Residue Identification and Characterization (WSRIC) book does not indicate the process use of any radionuclides other than Plutonium, Americium, or Uranium in B779.

- A thorough review of the source registry did not reveal the use of any beta only sources in B779 (with the exception of gaseous tritium and solid sealed sources which were periodically leak tested).

- Interviews with long-term building personnel that had first hand knowledge of processes confirmed that no beta only sources were used in B779 (except as noted).

Extensive beta characterization surveys will be performed in previous laboratories after the equipment strip-out is performed in B779 as discussed in Section 5.1.3. If beta contamination is detected above the unrestricted release criteria, then an investigation will be performed, and the radionuclide will be identified. If these characterization surveys do not reveal beta contamination above the unrestricted release criteria, then no additional beta surveys will be required for final survey.

5.1.4 Final Survey

Final surveys will be performed on an on-going basis on areas that have been stripped out and released for survey. Radiological survey instructions and survey maps (See Appendix E for an example of typical survey package information and instructions) will be provided to Radiological Operations by the Final Survey Radiological Engineer when the area is ready for final survey. Survey instructions for building survey units will be written in accordance with MARSSIM classifications. (See the 779 Survey Breakdown Structure for classifications) If fixed equipment remains in the buildings after strip-out, additional total contamination and removable contamination measurements will be obtained on the accessible surfaces of the equipment. An effort will be made to ensure a minimal number of inaccessible areas go un-surveyed. Hard to access areas such as corners of walls will be surveyed with portable instruments.

5.2 SEVEN STEP DQO PROCESS

The following seven step process derived from EPA QA/G-4, *The Data Quality Objective Process* and MARSSIM is being utilized to develop the CRSP for the 779 Cluster. The CRSP was designed to identify the survey requirements which when completed, demonstrate compliance with the unrestricted release criteria.

5.2.1 Step 1 - State the Problem

5.2.1.1 Why perform this survey?

This survey is being performed to assure that the 779 Cluster facilities' materials to be released contain no radioactive alpha contamination above the unrestricted release criteria outlined in Site Procedure 1-P73-HSP-18.10, *Radioactive Material Transfers and Unrestricted Release of Property and Waste.*

A thorough review of the RFETS source registry was performed to determine the type of radioactive material maintained in the 779 Cluster throughout its lifetime. Based on the source registry and process knowledge provided by long-term building personnel, the only DOE radioactive material maintained, other than solid instrument check sources, such as Co-57, Co-60, Cs-137, Fe55, Sr-90, and gaseous H-3 sources, is Americium, Plutonium, and Uranium. (With the exception of H-3 as discussed in Section 5.1.4.2) Therefore the unrestricted release criteria for alpha applies for the Building 779 Cluster. These limits are delineated as Derived Concentration Guideline Levels (DCGLs) by MARSSIM. The applicable DCGLs are as follows:

Removable Alpha	$DCGL_W$ Total Alpha (Average)*	$DCGL_{EMC}$ Total Alpha (Maximum)
20 dpm/100 cm^2	100 dpm/100 cm^2	300 dpm/100 cm^2

* If a value of 100 dpm/100 cm^2 or greater is detected with a portable instrument, eight additional measurements will be obtained over a 1 m^2 area. The average of the 9 measurements shall be less than 100 dpm/100 cm^2 for the area to meet the unrestricted release criteria of DOE Order 5400.5. If an automated surface contamination monitor is used the average for each 1 m^2 area shall be less than 100 dpm/100 cm^2.

5.2.1.2 What types and kind of sampling measurements are required?

Removable Contamination

Removable contamination measurements will be obtained to ensure removable contamination above the RFETS unrestricted release criteria does not exist on the exterior surfaces.

Paint/Surface Media Contamination

Paint/surface media samples will be obtained to ensure contamination above the RFETS unrestricted release criteria does not exist below painted surfaces or other forms of surface media such as roofing material, or floor adhesive or within the paint or roofing/adhesive material itself. It is anticipated that total surface activity measurements or surface media sampling will detect any contamination that has occurred on building surfaces. We have no evidence that contamination has migrated into cinder block, concrete, or any other base material and disappeared from the surface. Therefore it is not anticipated that volumetric samples will be required

Total Surface Contamination

A combination of the following will be used as necessary to perform total surface contamination surveys required to assure that the unrestricted release criteria for total surface gross alpha contamination:

AUTOMATED SURFACE CONTAMINATION MONITORS	PORTABLE INSTRUMENTS
SCMs may be utilized for the detection of total surface contamination provided the instrument's MDAs are approximately 50% of the associated RFETS unrestricted release criteria. The use of these monitors will fulfill the requirement for scan surveys in areas surveyed as well. If SCMs are used, inaccessible areas will be surveyed with portable detectors. The portable detector output may be input into the same information management system that is used by the SCMs to provide a seamless survey report.	Total surface contamination surveys for gross alpha contamination are performed at distinct locations in the 779 Cluster. Since small areas of radioactive material may be present between the total surface contamination measurements. Scan surveys will also be performed to ensure elevated areas above the unrestricted release criteria do not exist. These surveys are performed across defined areas.

5.2.1.3 Who needs the information?

The Department of Energy, Environmental Protection Agency, Colorado Department of Public Health and the Environment, Stakeholders, Kaiser-Hill, Safe Sites of Colorado and Rocky Mountain Remediation Services need the CRSP results.

5.2.1.4 When is the information needed?

The survey results from the CRSP are needed for each survey unit before the dismantlement of the survey area in the 779 Cluster. (e.g., Individual structures may be dismantled upon completion of the final survey for that specific structure.)

5.2.2 Step 2 - Identify the Decision

5.2.2.1 What decisions will be made from this final survey information?

Structures and components of the 779 Cluster will be released in an unrestricted manner when it is shown that the unrestricted release criteria are met.

If the surveys show that the areas in the 779 Cluster do not meet the unrestricted release criteria, the area exceeding the criteria will be decontaminated or removed. The decontaminated area will then be re-surveyed to assure that the unrestricted release criteria are met. If the unrestricted release criteria cannot be met, the area exceeding the criteria will not be released in an unrestricted manner. If unable to decontaminate the area, the material will be discarded as radioactive waste or if the area is part of the foundation which is going to remain in place for later environmental restoration, the area will be protected to prevent release to the environment and all proper radiological postings will be made.

5.2.2.2 Are there any alternatives to the decision?

There are no other alternatives for the 779 Cluster. The Site Utilization Review Board (SURB) and DOE Management have made the decision that the 779 Cluster facilities are excess.

5.2.2.3 What is the end use of the equipment, facility or structure (free release, restricted use, low-level waste, etc.)?

Structures and components within the 779 Cluster that have no radioactive material contamination above the unrestricted release criteria may be released in an unrestricted manner. If areas within the 779 Cluster contain radioactive material above the unrestricted release criteria and cannot be decontaminated, these areas will not be released in an unrestricted manner but instead will be handled as radioactive material and posted accordingly.

5.2.3 Step 3 - Identify Inputs to the Decision

5.2.3.1 What information is required to make this decision?

The information required are the radiological survey data that will support a decision to release the structures and components of the 779 Cluster in an unrestricted manner. The radiological surveys required are total surface and removable surveys for gross alpha contamination. These surveys are performed at distinct locations within the 779 Cluster. (See Appendix E for example radiological survey package information and instructions)

Scan surveys are performed in addition to total surface contamination and removable contamination surveys to locate radiation anomalies indicating residual gross activity that may require further investigation or action to ensure the probability of finding radioactive material above the unrestricted release criteria is maximized. These scan surveys are performed across a defined area within the 779 Cluster.

SCMs may be utilized in addition to portable instrumentation for the detection of total surface contamination provided the instrument's MDAs are at or below 50% of the associated RFETS unrestricted release criteria. The use of these monitors will fulfill the requirement for scan surveys.

Paint/surface media samples will be obtained to ensure contamination above the RFETS unrestricted release criteria does not exist below painted surfaces.

5.2.3.2 What source(s) can be used to obtain the information?

Reconnaissance level characterization surveys and in-process characterization surveys provide the required information. If these surveys do not satisfy the requirements of the CRSP, additional surveys will be required to ensure they are met.

5.2.3.3 Can the desired analyses be performed at RFETS or will the analysis be sent off-site?

All radiological survey data will be obtained and recorded at the 779 Cluster. This data will be reviewed at RFETS. Off-site laboratories will analyze surface media samples. The Independent Verification organization may send samples off-site for analysis as well.

5.2.3.4 What type of instrumentation will be required?

The instrumentation in Appendix A or a suitable replacement as determined by Radiological Engineering will be used to perform all radiological surveys. The Minimum Detectable Activities (MDA) of the instruments used to perform total and removable surveys required in this CRSP will be a fraction of the unrestricted release criteria. A goal will be to have the MDA of an instrument at or below 50% of the unrestricted release criteria for total and removable measurements. The NE Electra used to perform alpha scans is unable to achieve this goal but does provide the ability to detect the following: 1) a single count at a ½ inch/second scan rate > 50% of the time, and 2) a 2nd count within a reasonable period of time (6 seconds), 90% of the time at the alpha $DCGL_W$ of 100 dpm/100 cm^2. In addition, the scan MDC of the NE Electra at 1½ in./sec. is less then the applicable $DCGL_{EMC}$ for alpha. Additional survey equipment, approved for use at RFETS, may be used as required by Radiological Engineering.

5.2.3.5 Has facility structural data been reviewed?

Qualified structural engineers are reviewing structural data on an ongoing basis. Prior to modifications to the building structures, approval will be obtained from Engineering.

5.2.3.6 What suspect materials have been identified?

Plutonium, americium, and uranium contamination have been identified as the only nuclides resulting from DOE operations present in the 779 Cluster. Buildings 779, 782 and 729 contain Radiological Buffer Areas, Contamination Areas and High Contamination Areas that contain isotopes of americium, plutonium and uranium. (See the 779 Survey Breakdown Structure for classifications)

5.2.4 Step 4 - Define the Study Boundaries

5.2.4.1 What is the scope of this final survey?

The floors, walls, ceilings, roof, and fixed equipment in the 779 Cluster will be surveyed. Concrete and asphalt surfaces, soil and utilities not physically part of the 779 structures are not within the scope of this CRSP.

5.2.4.2 What is the sample population of interest?

The floors, interior and exterior walls, ceiling, roof and fixed equipment located within the 779 Cluster are the population of interest.

5.2.4.3 What kind of radiological hazard is being evaluated?

Total surface and removable radioactive contamination is present throughout the 779 Cluster and is the hazard being evaluated. The known radioactive material present is plutonium, americium, and uranium. These nuclides are primarily high-energy alpha emitters and are therefore considered skin and internal dose hazards. There are four modes of entry of radioactive material into the body: inhalation and deposition in the respiratory tract; injection; ingestion; and absorption through the skin. Plutonium is the primary nuclide of concern. The principle organs affected by plutonium with the corresponding typical biological half-lives are as follows:

Lungs	0.5 to 500 days based on the solubility of the radioactive material
Liver	20 years
Bones	50 years

To put the hazard into perspective, an acute exposure to a worker from the inhalation of about 5,000 picocuries of Pu-239 in an oxide form would result in a first year and 50-year committed effective dose equivalent of 150 millirem.

5.2.4.4 Are there any constraints on data collection?

Data collection is performed in accordance with the requirements of MARSSIM. The survey methods to be utilized are in conformance with the following RFETS procedures, and regulatory documents:

3-PRO-165-RSP-07.02, *Contamination Monitoring Requirements*
3-PRO-141-RSP-09.01, *Unrestricted Release of Property, Material, Equipment and Waste*
1-P73-HSP-18.10, *Radioactive Material Transfer and Unrestricted Release of Property and Waste*
DOE Order 5400.5, *Radiation Protection of the Public and the Environment*

5.2.4.5 What sample measurement locations (densities) are necessary to get the desired certainty?

All areas of the building cluster do not have the same potential for radioactive material being present and, therefore, do not require the same level of survey coverage to achieve an appropriate level of confidence that building surfaces satisfy established unrestricted release criteria. The CRSP is designed so that areas with higher potential for contamination receive a higher degree of survey effort. This will ensure that the CRSP is both effective and efficient.

The following area classifications with their associated survey frequencies are based on guidance from MARSSIM - *Multi-Agency Radiation Survey and Site Investigation Manual, 12/97.*

Four area classifications were used to design the 779 Cluster CRSP. These classifications are defined as follows:

- Impacted Class 1 Areas: are areas that have potential contamination (based on building operating history) or known contamination (based on past or preliminary characterization survey data). This would normally include areas where radioactive materials were used and stored and where records indicate spills or other unusual occurrences could have resulted in the spread of contamination.

- Impacted Class 2 Areas: are areas that have or had a potential for radioactive contamination or known contamination, but are not expected to exceed the applicable contamination limits.

- Impacted Class 3 Areas: are all areas not classified as Impacted Class 1, Impacted Class 2 or Non-impacted. These areas are not expected to contain residual contamination above the applicable limits, based on knowledge of building history and previous survey information. However, insufficient documentation is present to exclude the area from survey requirements.

- Non-Impacted Areas: are all areas not classified as Impacted Class 1, Impacted Class 2 or Impacted Class 3. These areas are areas where there is no reasonable potential for residual contamination, based on knowledge of building history and/or previous survey information. Sufficient information is present to be assured that no residual contamination is present above the applicable limits.

5.2.4.6 To what radiological hazards could the worker be exposed?

High levels of plutonium, americium, and uranium presently exist in the glove boxes, and ventilation systems. These nuclides present a significant internal radiological hazard if inhaled or ingested. From an external dose standpoint, the radiological hazard is minimal. These glove boxes and ventilation systems will be removed from areas prior to characterization and final survey, This radiological hazard applies to final survey personnel working in areas which have previously been stripped out only because of the residual radioactivity that could still be present.

5.2.5 Step 5 - Develop a Decision Rule

5.2.5.1 What is the basis for the decision in Step 2?

The unrestricted release criterion is the basis for deciding whether the structures and components of the 779 Cluster can be released in an unrestricted manner. The survey frequency required allowing an unrestricted release is based on guidance from MARSSIM.

5.2.5.2 Are there any regulatory and statistical drivers for sampling frequency?

The survey frequency required allowing an unrestricted release is based on guidance from:

- MARSSIM - *Multi-Agency Radiation Survey and Site Investigation Manual, 12/97.*
- 1-P73-HSP-18.10, *Radioactive Material Transfer and Unrestricted Release of Property and Waste.*

5.2.5.3 What are the required instrumentation sensitivities?

The instrumentation in Appendix A or a suitable replacement as determined by Radiological Engineering will be used to perform all radiological surveys. The Minimum Detectable Activities (MDA) of the instruments used to perform total and removable surveys required in this CRSP will be a fraction of the unrestricted release criteria. A goal will be to have the MDA of an instrument at or below 50% of the unrestricted release criteria for total and removable measurements. The NE Electra used to perform alpha scans is unable to achieve this goal but does provide the ability to detect the following: 1) a single count at a ½ inch/second scan rate > 50% of the time, and 2) a 2nd count within a reasonable period of time (6 seconds), 90% of the time at the alpha $DCGL_W$ of 100 dpm/100 cm^2. In addition, the scan MDC of the NE Electra at 1½ in./sec. is less then the applicable $DCGL_{EMC}$ for alpha. Additional survey equipment, approved for use at RFETS, may be used as required by Radiological Engineering.

5.2.5.4 What action levels are applicable to the decision or parameter of interest?

A thorough review of the RFETS source registry was performed to determine the type of radioactive material maintained in the 779 Cluster. Based on the source registry and process knowledge provided by long-term building personnel, the only DOE radioactive material maintained other than solid instrument check sources such as Co-57, Co-60, Cs-137, Fe55, Sr-90, and gaseous H-3 sources is Americium, Plutonium, and Uranium. Therefore the unrestricted release criteria for the Building 779 Cluster delineated in DOE 5400.5 apply. These limits are delineated as Derived Concentration Guideline Levels (DCGLs) by MARSSIM. These DCGLs are as follows:

Removable Alpha	$DCGL_W$ Total Alpha (Average)*	$DCGL_{EMC}$ Total Alpha (Maximum)
20 dpm/100 cm^2	100 dpm/100 cm^2	300 dpm/100 cm^2

*If a value of 100 dpm/100 cm^2 or greater is detected with a portable instrument, eight additional measurements will be obtained over a 1 m^2 area. The average of the 9 measurements shall be less than 100 dpm/100 cm^2 for the area to meet the unrestricted release criteria of DOE Order 5400.5. If an automated surface contamination monitor is used the average for each 1 m^2 area shall be less than 100 dpm/100 cm^2.

5.2.5.5 Define the decisions using "if...then" statements.

- If the structures and components of the 779 Cluster contain no radioactive material above the unrestricted release criteria, then those components may be released in an unrestricted manner.
- If the structures and components of the 779 Cluster contain radioactive material above the unrestricted release criteria, then those components will be decontaminated or removed and disposed of as radioactive waste.
- If decontaminated structures and components of 779 Cluster contain radioactive material above the unrestricted release criteria, then those components will not be released in an unrestricted manner.

- If removed materials (structures and components) are radioactively contaminated, then those removed materials will not be released in an unrestricted manner and will be disposed of as radioactive waste.

5.2.6 Step 6 - Specify Limits on Decision Errors

5.2.6.1 What sample size is necessary for the analysis being completed?

The sample size is defined for different units in the 779 Cluster as outlined below. In addition, the survey units are typically limited in size to ensure each area is assigned an adequate number of data points. The suggested maximum floor surface areas for survey units are;

- Up to 100 m^2 floor area for Impacted Class 1 Areas
- 100 - 1000 m^2 floor area for Impacted Class 2 Areas
- No limit for Impacted Class 3 Areas

These size restrictions are guidelines. If additional measurements are taken, for the convenience of unit classifications, larger floor surface areas may be used. (For example, if an area is classified as Impacted Class 1 and has 200 m^2 of floor surface area and it is easier to keep it as one survey unit rather than being divided into 2 survey units, then the number of measurements calculated would be multiplied by 2 to account for the increased surface area.) In addition, no survey units will be less than 10 m^2 in size in order to achieve an acceptable sample population.

The floors, walls, ceilings, roof and fixed equipment will be surveyed for total surface and removable, gross alpha contamination as indicated in the survey instructions to be provided (see example in Appendix E).

5.2.6.2 What number of samples/measurements will provide the desired certainty?

Non-Impacted Area Survey and Sampling Requirements

No surveys or samples are required.

Classifications for survey requirements will be made as delineated in MARSSIM. Initial classifications for the 779 Cluster are Impacted Classes 1, 2 and 3. Initial classifications of areas may be downgraded during characterization and in-process surveying based on engineering judgment by Radiological Engineering.

Impacted Class 1, Class 2, and Class 3 Area Survey and Sampling Requirements

Removable Contamination

Removable activity measurements as calculated using MARSSIM statistical calculations will be used to satisfy Impacted Class 1, Impacted Class 2, and Impacted Class 3 Survey Requirements (See example for removable contamination later in this section)

Paint/Surface Media Samples

Paint/surface media samples will be obtained to ensure contamination above the RFETS unrestricted release criteria does not exist below painted surfaces. If the potential for extensive contamination exists in and below the painted surface, in an impacted class 1 area, the paint may need to be stripped off prior to final survey. Otherwise, the quantity of samples will be determined based on MARSSIM statistical calculations to satisfy Impacted Class 1, Impacted Class 2, and Impacted Class 3 Survey Requirements. (See the MARSSIM Sample Calculation for paint/surface media samples later in this section)

Total Surface Contamination Monitoring

One of the following will be used to perform contamination surveys required to assure that the unrestricted release criteria for total surface gross alpha contamination are met:

AUTOMATED SURFACE CONTAMINATION MONITORS	PORTABLE INSTRUMENTS
SCMs will be utilized to perform total surface contamination surveys of areas of concern in the B779 Cluster. These monitors obtain approximately four hundred 25-cm^2 measurements for each m^2 surveyed. The maximum, minimum, mean and standard deviation of each 25-cm^2 measurement is also calculated for each m^2. Therefore, the use of these monitors fulfills the requirement for scan surveys as well. SCMs will use portable detectors to perform scan surveys and total surface contamination survey areas for all areas inaccessible. The use of the SCMs in conjunction with portable detectors will enable the acquisition of quantities of data far in excess of MARSSIM statistical requirements. Therefore MARSSIM statistical guidance does not apply for their use. The following classifications and survey requirements shall apply: **Impacted Class 1 Area Survey Requirements** • A 100% alpha scan with the automated surface contamination monitor on accessible surfaces. Inaccessible areas will be surveyed with portable detectors. • Total surface alpha activity measurements will be obtained at a frequency in excess of MARSSIM requirements. **Impacted Class 2 Area Survey Requirements** • A 10 – 100% alpha scan with the automated surface contamination monitor on accessible surfaces. Inaccessible areas will be surveyed with portable detectors. • Total surface alpha activity measurements will be obtained at a frequency in excess of MARSSIM requirements. **Impacted Class 3 Area Survey Requirements** • A 10% alpha scan with the automated surface contamination monitor on accessible surfaces. Inaccessible areas will be surveyed with portable detectors. • Total surface activity measurements for alpha will be obtained at a frequency in excess of MARSSIM requirements.	Portable instruments will be used to perform scan surveys and total surface contamination surveys. The number of survey measurements will be determined using MARSSIM statistical calculation methodology (See the following example calculation for total surface contamination measurements.) Detailed instructions for each survey unit will be prescribed by the final survey radiological engineer and reviewed by an independent radiological engineer. The following classifications and survey requirements shall apply: **Impacted Class 1 Area Survey Requirements** • A 100% alpha scan will be performed on accessible surfaces. • Total surface activity measurements for alpha as calculated using MARSSIM statistical calculations. **Impacted Class 2 Area Survey Requirements** • A 10 – 100% alpha scan based on total surface area will be performed on selected biased locations. • Total surface alpha activity measurements based on MARSSIM statistical calculations. **Impacted Class 3 Area Survey Requirements** • A 10% alpha scan based on total survey surface area will be performed on selected biased locations • Total surface alpha activity measurements based on MARSSIM statistical calculations.

MARSSIM Sample Calculations

Total Contamination Measurements

An example of how to calculate the quantity of total contamination measurements for a survey unit using MARSSIM guidelines is as follows:

Determine the relative shift as follows:

$DCGL_{total} - LBGR_{total} / SD_{total} = \Delta\delta$

Where: $\Delta\delta$ is the relative shift or the resolution of measurements in units of measurement uncertainty (should be 1 to 3)

$DCGL_{total}$ is the derived concentration guideline value (The total contamination limit)

$LBGR_{total}$ is the lower bound of the gray region - the lower bound of the range of values of the parameter of interest in a survey unit where the consequences of making a decision error is relatively minor (initially 50% of DCGL)

SD_{total} is the typical standard deviation of the total surface measurements (assume 30 dpm based on a 30% CV as recommended by MARSSIM until additional data is obtained)

(100 - 50)/30 = 1.67

Determine the Sign P value by looking up $\Delta\delta$ in Table 5.4 of MARSSIM (the Sign P value is the estimated probability that a random measurement from the survey unit will be less than the DCGL when the survey unit median is actually at the LBGR). The value from the table is 0.95 for a relative shift of 1.67

Determine the number of total surface contamination measurements for the applicable survey unit using the following MARSSIM formula that is based on Plutonium contaminants not being present in the background:

$N = (1.645 + 1.645)^2 / 4(\text{Sign P} - 0.5)^2$

Where: 1.645 is the alpha and beta decision error values (95% confidence)

$N = (3.29)^2 / 4(0.95\text{-}0.5)^2 = 13.4$
(increase value by 20% to allow for missing or invalid data points) = 13.4 • 1.2 = 16.

Therefore 16 total surface contamination measurements would be required for the applicable survey unit.

Removable Contamination Measurements

An example of how to calculate the quantity of removable contamination measurements for a survey unit using MARSSIM guidelines is as follows:

Determine the relative shift as follows:

$DCGL_{removable} - LBGR_{removable} / SD_{removable} = \Delta\delta$

Where: $\Delta\delta$ is the relative shift or the resolution of measurements in units of measurement uncertainty (should be 1 to 3)

$DCGL_{removable}$ is the derived concentration guideline value (The total contamination limit)

$LBGR_{removable}$ is the lower bound of the gray region - the lower bound of the range of values of the parameter of interest in a survey unit where the consequences of making a decision error is relatively minor (initially 50% of DCGL)

$SD_{removable}$ is the typical standard deviation of the removable contamination measurements (assume 6 dpm based on a 30% CV as recommended by MARSSIM until additional data is obtained)

(20 - 10)/6 = 1.67

Determine the Sign P value by looking up $\Delta\delta$ in Table 5.4 of MARSSIM (the Sign P value is the estimated probability that a random measurement from the survey unit will be less than the DCGL when the survey unit median is actually at the LBGR). The value from the table is 0.95 for a relative shift of 1.67

Determine the number of removable contamination measurements for the applicable survey unit using the following MARSSIM formula that is based on Plutonium contaminants not being present in the background:
$N = (1.645 + 1.645)^2 / 4(\text{Sign P} - 0.5)^2$

Where: 1.645 is the alpha and beta decision error values (95% confidence)

$N = (3.29)^2 / 4(0.95\text{-}0.5)^2 = 13.4$
(increase value by 20% to allow for missing or invalid data points) = 13.4 * 1.2 = 16.

Therefore 16 removable contamination measurements would be required for the applicable survey unit.

Paint/Surface Media Samples

An example of how to calculate the quantity of paint/surface media samples for a survey unit using MARSSIM guidelines is as follows:

Determine the relative shift as follows:

$DCGL_{media} - LBGR_{media} / SD_{media} = \Delta\delta$

Where: $\Delta\delta$ is the relative shift or the resolution of measurements in units of measurement uncertainty (should be 1 to 3)
$DCGL_{media}$ is the derived concentration guideline value (The total contamination limit)
$LBGR_{media}$ is the lower bound of the gray region - the lower bound of the range of values of the parameter of interest in a survey unit where the consequences of making a decision error is relatively minor (initially 50% of DCGL)
SD_{media} is the typical standard deviation of the paint/surface media samples (assume 30 dpm based on a 30% CV as recommended by MARSSIM until additional data is obtained)

(100 - 50)/30 = 1.67

Determine the Sign P value by looking up $\Delta\delta$ in Table 5.4 of MARSSIM (the Sign P value is the estimated probability that a random sample from the survey unit will be less than the DCGL when the survey unit median is actually at the LBGR). The value from the table is 0.95 for a relative shift of 1.67

Determine the number of paint/surface media samples for the applicable survey unit using the following MARSSIM formula that is based on plutonium contaminants not being present in the background:

$N = (1.645 + 1.645)^2 / 4(\text{Sign P} - 0.5)^2$

Where: 1.645 is the alpha and beta decision error values (95% confidence)

$N = (3.29)^2 / 4(0.95\text{-}0.5)^2 = 13.4$
(Increase value by 20% to allow for missing or invalid data points) = 13.4 * 1.2 = 16.

Therefore 16 paint/surface media samples would be required for the applicable survey unit.

Determination of Type of Non-parametric Test

Because contaminants of concern are not present to an appreciable extent in the background for the B779 Cluster, the one sample statistical test was selected for the determination of the number of sample points to be obtained for survey units. Until additional characterization survey data is obtained, a standard deviation of 30 dpm for paint/solid media and total contamination and 10 dpm for removable contamination based on a 30% CV as recommended by MARSSIM guidance will be used as part of the one sample statistical test calculation.

5.2.6.3 What is the expected range of the parameter of interest?

All parameter values are expected to be less than the unrestricted release criteria and are reported in disintegrations per minute.

5.2.6.4 Define both types of decision errors, (false negative and false positive)?

False negative (Type 1) errors would occur when a detector's response is below the unrestricted release criteria when, in fact, radioactive material is present above the unrestricted release criteria.

False positive (Type 2) errors would occur when a detectors response is above the unrestricted release criteria when, in fact, radioactive material is not present above the unrestricted release criteria.

5.2.6.5 What are the potential consequences of an incorrect decision?

For false negative errors, area/material would be released in an unrestricted manner when it should not be released in an unrestricted manner.

For false positive errors, area/material would not be released in an unrestricted manner when it should be released in an unrestricted manner.

5.2.6.6 What are the limits on decision errors?

The alpha and beta decision errors used at RFETS are typically 5%. This corresponds to a 95% confidence level. The instrumentation in Appendix A or a suitable replacement as determined by Radiological Engineering will be used to perform all radiological surveys. The Minimum Detectable Activities (MDA) of the instruments used to perform total and removable surveys required in this CRSP will be a fraction of the unrestricted release criteria. A goal will be to have the MDA of an instrument at or below 50% of the unrestricted release criteria for total and removable measurements. The NE Electra used to perform alpha scans is unable to achieve this goal but does provide the ability to detect the following: 1) a single count at a ½ inch/second scan rate > 50% of the time, and 2) a 2nd count within a reasonable period of time (6 seconds), 90% of the time at the alpha $DCGL_W$ of 100 dpm/100 cm^2. In addition, the scan MDC of the NE Electra at 1½ in./sec. is less then the applicable $DCGL_{EMC}$ for alpha. Additional survey equipment, approved for use at RFETS, may be used as required by Radiological Engineering. Daily MDAs are calculated for each survey instrument. The use of these instruments with associated MDAs below the unrestricted release criteria can assure that false negative and false positive errors are minimized.

5.2.7 Step 7 - Optimize the Decision for Obtaining Data

5.2.7.1 What method will be used to obtain the desired information?

The survey methods to be utilized are in conformance with the following RFETS procedures, and regulatory documents:

3-PRO-165-RSP-07.02, *Contamination Monitoring Requirements*

3-PRO-141-RSP-09.01, *Unrestricted Release of Property, Material, Equipment and Waste*

1-P73-HSP-18.10, *Radioactive Material Transfer and Unrestricted Release of Property and Waste*

DOE Order 5400.5, *Radiation Protection of the Public and the Environment*

In addition, the following documents were used for reference:

NRC Reg. Guide 1.86, *Termination of Operating Licenses for Nuclear Reactors*

NUREG/CR-6450, Characterization of Contamination Through the Use of Position Sensitive Detectors and Digital Image Processing

5.2.7.2 What level of worker protection is required to perform survey and other work in the facility, structure or environs?

Standard industrial safety practices are utilized. Worker personnel protection clothing is identified in the Activity Hazard Analysis and Radiological Work Permit, if required. When final surveys are scheduled to be performed, it is not suspected that removable radioactive contamination will be present on the surfaces being surveyed. Therefore, no radiological personnel protection equipment is required.

5.2.7.3 How will the survey design be optimized?

One of the following will be used to ensure the survey design is optimized:

AUTOMATED SURFACE CONTAMINATION MONITORS	PORTABLE INSTRUMENTS
SCMs and associated survey information management systems may be utilized in addition to portable instrumentation for many surface contamination surveys. In this case, gridding will not be required since the Survey Information Management System with the use of video cameras and precise location tracking allows for survey location reproducibility Instrument calibrations are performed every 6 months, and calibration response and background checks performed at least once per shift in accordance with approved RFETS procedures and NIST traceable sources.	Measurement locations will be clearly identified to provide a method of referencing survey results to survey measurement locations. Gridding may be used for the floors, walls and ceilings/roofs for units with Impacted Class 1 or Impacted Class 2 final classifications. In units where gridding is not practical or cost-effective, measurement locations will be marked with labels or similar method and delineated on a map as directed by Radiological Engineering. Instrument calibrations are performed every 6 months, and calibration response and background checks performed daily prior to use in accordance with approved RFETS procedures and NIST traceable sources.

5.2.7.4 Have data quantity and quality assurance requirements for sampling been reviewed and incorporated into the survey process?

Quality assurance is addressed in Section 16.0 of this CRSP. The survey reports are prepared and reviewed in accordance with RFETS procedures.

6.0 RADIOLOGICAL RELEASE CRITERIA

The surface contamination criteria from DOE Order 5400.5 will be used as the release criteria for final survey. The survey methods and release criteria are in conformance with the following RFETS procedures and regulatory documents:

3-PRO-165-RSP-07.02, *Contamination Monitoring Requirements*
3-PRO-141-RSP-09.01, *Unrestricted Release of Property, Material, Equipment and Waste*
1-P73-HSP-18.10, *Radioactive Material Transfer and Unrestricted Release of Property and Waste*
DOE Order 5400.5, *Radiation Protection of the Public and the Environment*

In addition, the following documents were used for reference:

NRC Reg. Guide 1.86, *Termination of Operating Licenses for Nuclear Reactors*
NUREG/CR-6450, Characterization of Contamination Through the Use of Position Sensitive Detectors and Digital Image Processing

7.0 CLASSIFICATION OF AREAS BY CONTAMINATION POTENTIAL

All areas of the building cluster do not have the same potential for residual contamination and, therefore, do not require the same level of survey coverage to achieve an appropriate level of confidence that building surfaces satisfy established release criteria. This plan is designed such that areas with higher potential for contamination receive a higher degree of survey effort. This will ensure that the Closeout radiological survey process is both effective and efficient.

A stand-alone document, the 779 Cluster Survey Breakdown Structure is being prepared to delineate the survey units and classifications for each. This document will be revised periodically as survey units change based on reclassification or combining of units based on modifications such as wall removal. This document will undergo an approval process by project management and radiological engineering.

The following classifications and survey frequencies are based on the guidance from MARSSIM - *Multi-Agency Radiation Survey and Site Investigation Manual, 12/1997*:

- Impacted Class 1 Areas: are areas that have potential contamination (based on building operating history) or known contamination (based on past or preliminary characterization survey data). This would normally include areas where radioactive materials were used and stored and where records indicate spills or other unusual occurrences could have resulted in the spread of contamination.
- Impacted Class 2 Areas: are areas that have or had a potential for radioactive contamination or known contamination, but are not expected to exceed the applicable contamination limits.
- Impacted Class 3 Areas: are all areas not classified as Impacted Class 1 or Impacted Class 2 or Non-Impacted. These areas are not expected to contain residual contamination above the applicable limits, based on knowledge of building history and previous survey information. However, insufficient documentation is present to exclude the area from survey requirements.
- Non-Impacted Areas: are all areas not classified as Impacted Class 1, Impacted Class 2 or Impacted Class 3. These areas are areas where there is no reasonable potential for residual contamination, based on knowledge of building history and/or previous survey information. Sufficient information is present to be assured that no residual contamination is present above the applicable contamination limits.

8.0 INVESTIGATIONS

Investigations are performed based on updated survey information. Investigation Documentation Forms will be completed for each incident in which contamination for any survey unit exceeds any of the following conditions (See Appendix E for example investigation form):

Impacted Class 1 and Class 2 Areas	Impacted Class 3 Areas
• Contamination is discovered above the maximum $DCGL_{EMC}$ • The average of nine measurements exceeds the average $DCGL_W$ for any 1 m^2 as measured with portable instrumentation • The average value for any 1 m^2 area, measured with an automated surface contamination monitor exceeds the average $DCGL_W$.	• Contamination exceeds 75% of the average $DCGL_W$ for any single measurement as measured with portable instrumentation or • The average value for any 1-m2 area, measured with an automated surface contamination monitor exceeds 75% of the average $DCGL_W$.

8.1 SURVEY UNIT RECLASSIFICATION

Survey units within the above survey area classifications may require reclassification based on updated survey information. The following guidelines will be used to determine the new classification:

8.1.1 UPWARD RECLASSIFICATION

In the event one of the conditions in Section 8.0 occurs, then a more restrictive classification will be applied based on the following guidelines:

Impacted Class 2 and Class 3 Areas

- The investigation survey area will be increased to encompass the new areas of contamination as directed by radiological engineering in investigation survey instructions.
- The scan frequency will be increased to 100% of the investigation survey unit.

8.1.2 DOWNWARD RECLASSIFICATION

Based on characterization survey results and sound engineering judgment, areas may be downgraded if the new classification criteria are met. For example, an Impacted Class 1 area with extensive survey results that indicate that contamination levels are not expected to exceed the applicable DCGL may be reclassified as Impacted Class 2.

9.0 RADIOLOGICAL SURVEY SAMPLING METHODS AND FREQUENCY

The sampling frequency specified for the following classifications is based on MARSSIM calculations. The accessible areas of floors, interior walls, ceiling, exterior walls, roof and fixed equipment will be surveyed for total and removable alpha contamination as indicated in the survey instructions provided in Appendix E, and in accordance with Sections 9.1 through 9.3:

SCMs may be utilized in addition to portable instrumentation for the detection of total surface contamination, including scans, provided the instrument's MDAs are a fraction of the associated RFETS unrestricted release criteria. The number of measurements provided by the surface contamination monitor shall be greater than the MARSSIM statistical calculations determined for each survey unit as delineated for each survey classification below. The use of SCMs shall not preclude removable contamination surveys and paint/surface sampling for each survey unit.

9.1 SURVEY AREAS CLASSIFIED AS IMPACTED CLASS 1

If portable instruments are used exclusively, the number of total surface and removable alpha measurements for floors, walls, ceilings, roofs, and fixed equipment will be calculated based on MARSSIM statistical calculations, and applying the survey unit size limitation delineated in Section 5.2.6.1. In addition, a 100% alpha scan will be performed on all accessible surfaces.

Paint/surface media samples may be obtained to ensure contamination above the RFETS unrestricted release criteria does not exist below painted surfaces. If the potential for extensive contamination exists in and below the painted surface, in an Impacted Class 1 area, the paint may need to be stripped off prior to final survey. Otherwise, the quantity of samples will be determined based on MARSSIM statistical calculations to satisfy Impacted Class 1, Impacted Class 2, and Impacted Class 3 Survey Requirements. (See Appendix D for sampling methodology.)

9.2 SURVEY AREAS CLASSIFIED AS IMPACTED CLASS 2

If portable instruments are used exclusively, the number of total surface and removable alpha measurements for floors, walls, ceilings, roofs, and fixed equipment will be calculated based on MARSSIM statistical calculations and applying the survey unit size limitation delineated in Section 5.2.6.1. In addition, a 10 to 100% alpha scan will be performed at biased locations on accessible surfaces. The % scan will be determined based on the percentage of elevated characterization measurements that exceed 75% of the applicable DCGL for each area using the following guideline:

number of measurements exceeding 75% of the DCGL	% scan
1 or less	10
> 1 to 5	50
> 5	100

Paint/surface media samples will be obtained to ensure contamination above the RFETS unrestricted release criteria does not exist below and within painted surfaces. The quantity of surface media samples will be determined based on MARSSIM statistical calculations (See Appendix D for sampling methodology).

9.3 SURVEY AREAS CLASSIFIED AS IMPACTED CLASS 3

If portable instruments are used exclusively, the number of total surface and removable alpha measurements for floors, walls, ceilings, roofs, and fixed equipment will be calculated based on MARSSIM statistical calculations and applying the survey unit size limitation delineated in Section 5.2.6.1. In addition, a 10% alpha scan will be performed at biased locations on accessible surfaces.

Paint/surface media samples will be obtained to ensure contamination above the RFETS unrestricted release criteria does not exist below and within painted surfaces. The quantity of surface media samples will be determined based on MARSSIM statistical calculations (See Appendix D for sampling methodology).

10.0 FINAL SURVEY ISOLATION CONTROLS

Two levels of isolation controls will be established during and after the final survey for each area in the B779 Cluster. The level of isolation control will be based on the classification of the survey unit and the potential for cross contamination or re-contamination.

10.1 DISCUSSION

Implementation of isolation control measures is required to ensure areas prepared for final survey remain below the free release criteria for radiological contamination during and after final survey.

For survey units or groups of survey units, the use of postings and physical barriers will provide visible indicators of areas and equipment that have been surveyed and for which isolation controls have been established. These postings will consist of signs, ropes, or other similar barriers.

Radioactive material with the exception of instrumentation calibration check sources will be restricted from these isolation control areas.

The applicable areas with established isolation controls will have investigation surveys performed subsequent to any potentially contaminating events as determined by radiological engineering.

10.2 LEVELS OF ISOLATION CONTROLS

10.2.1 Level 1

Areas where the potential for the spread of contamination or the movement of radioactive material is significant may be classified as Level 1 and would require restrictive controls. Typical Level 1 areas would be areas adjacent to CAs or RBAs or areas where radioactive material is stored (except instrumentation calibration check sources).

Mandatory isolation controls would be the following, as applicable:

- Training of personnel on isolation controls
- Approval from the Radiation Safety Authority, or designee, for radioactive material transfers through the area
- Posting appropriate labels at access points
- Locking entrances

Additional isolation controls would be the following, as determined by radiological engineering, as applicable:

- Installing temporary personnel barriers with step-off pads and survey instrumentation for monitoring prior to entering
- Installing tamper-indicating devices
- Additional isolation controls as appropriate

10.2.2 Level 2

Areas where the potential for the spread of contamination or the movement of radioactive material (except instrumentation calibration check sources) is not significant, may be classified as Level 2. Typical Level 2 areas would be B729 and B782 after contaminated plenum removal, office areas not adjacent to CAs, and support structures outside of B779.

Mandatory isolation controls would be the following as applicable:

- Training of personnel on isolation controls
- Approval from the Radiation Safety Authority, or designee, for radioactive material transfers through the area
- Posting appropriate labels at access points

Additional isolation controls as appropriate, as determined by radiological engineering.

10.3 ISOLATION CONTROL IMPLEMENTATION

The final survey radiological engineer for each individual survey package will delineate isolation controls. Prior to the start of final survey, the Radiation Safety Authority or designee shall ensure that prescribed isolation control measures are in place for the specific survey unit(s) as delineated in the individual survey package.

11.0 INDEPENDENT VERIFICATION

An independent verification will be performed by an outside agency. This verification will consist of a thorough review of documentation and data from final survey activities and may include independent measurements as well. It is anticipated that this independent verification will be an ongoing evolution beginning with B729 prior to its decommissioning. The Independent Verification Contractor will work with the B779 Cluster personnel to address problems during the survey process and to minimize schedule conflicts at project completion. The percent of independent measurements, if obtained, will be determined by the agency performing the independent verification and project oversight.

12.0 GRIDDING METHODOLOGY

When utilized, grid measurements will consist of a random start grid pattern (See Appendix B for a typical triangular grid map). The following equation will be utilized to determine the appropriate grid spacing.

For triangular grids

$L = SQRT[A/(0.866*n)]$

Where: A = total surface area of the survey unit
n = number of measurements as calculated using the one sample statistical test
0.866 = constant provided by MARSSIM for triangular grid determination
L = the calculated distance between grid points

For rectangular grids

$L = SQRT[A/(n)]$

Where: A = total surface area of the survey unit
n = number of measurements as calculated using the one sample statistical test
L = the calculated distance between grid points

Once the distance between points is calculated, a random starting point will be determined using a random number generation system. The actual measurements will be taken at each grid intersection. If unable to obtain the measurement at the grid intersection due to interferences, the measurement will be obtained as close as possible to the grid intersection and the new location annotated on the survey map.

A combination of the following delineates grid requirements.

AUTOMATED SURFACE CONTAMINATION MONITORS	PORTABLE INSTRUMENTATION
SCMs and associated survey information management systems may be utilized in addition to portable instrumentation for many surface contamination surveys. In this case, gridding and marking total surface contamination measurement locations will not be required for total surface contamination measurements since the Survey Information Management System, with the use of precise location tracking, allows for precise survey location reproducibility. However, survey labels or markers will be used for removable measurements and paint/surface media samples taken in these areas surveyed with SCMs.	Measurement locations will be clearly identified by paint, permanent markers, or labels to provide a method of referencing survey results to survey measurement locations. These measurement locations will be delineated on a grid map at survey densities as directed by Radiological Engineering. A typical reference coordinate system for the purpose of gridding is delineated in Appendix B. If gridding is required, this type of coordinate system can be used to ensure each survey measurement location for a given survey unit is unique. In addition, survey maps with a similar type of gridding system will be provided prior to the performance of the final survey for each Impacted Class 1 or Impacted Class 2 area.

13.0 RESPONSIBILITIES

13.1 DIRECTOR, B779 (RMRS)

The Director is responsible for reviewing and approving the 779 Cluster Decommissioning Project Closeout Radiological Survey Plan and Report.

13.2 INTEGRATION MANAGER, B779 (RMRS)

The Integration Manager is responsible for reviewing and approving the 779 Cluster Decommissioning Project Closeout Radiological Survey Plan and Report.

13.3 RADIOLOGICAL SAFETY MANAGER, B779 (RMRS)

The Radiological Safety Manager is responsible for:

- Providing overall Radiological Engineering guidance for the development of the 779 Cluster Decommissioning Project Closeout Radiological Survey Plan, including the evaluation and classification of the areas for survey.
- Reviewing and approving the 779 Cluster Decommissioning Project Closeout Radiological Survey Plan, and Report as well as the 779 Cluster Survey Breakdown Structure.

13.4 RADIOLOGICAL ENGINEERING FIELD SERVICES MANAGER (RMRS)

The Radiological Engineering Field Services Manager is responsible for reviewing and approving the 779 Cluster Decommissioning Project Closeout Radiological Survey Plan and Report as well as the 779 Cluster Survey Breakdown Structure.

13.5 RADIOLOGICAL ENGINEERING SUPPORT SERVICES MANAGER (RMRS)

The Radiological Engineering Field Services Manager is responsible for reviewing and approving the 779 Cluster Decommissioning Project Closeout Radiological Survey Plan and Report as well as the 779 Cluster Survey Breakdown Structure.

13.6 779 CLOSURE FINAL SURVEY RADIOLOGICAL ENGINEER

The Final Survey Radiological Engineer is responsible for:

- Defining the content and ensuring preparation of the 779 Cluster Decommissioning Project Closeout Radiological Survey Plan and Report as well as the 779 Cluster Survey Breakdown Structure.
- Evaluating the project structures and appropriately classifies the areas for survey. Developing overall technical aspects, planning, and scheduling for implementation of the Closeout Radiological Survey Plan.
- Developing radiological survey instructions for individual survey units.
- Resolving issues regarding survey layout and gridding requirements.
- Reviewing surveys and sample analysis results for completeness, accuracy, and legibility.

13.7 779 CLOSURE RCT TECHNICAL SUPERVISORS

The RCT Technical Supervisors are responsible for:

- Reviewing and approving the 779 Cluster Decommissioning Project Closeout Radiological Survey Plan and Report
- Reviewing survey data for completeness, accuracy, legibility. Ensuring discrepancies in survey data are identified and corrected.
- Day-to-day supervision of the RCTs.

13.8 RADIOLOGICAL CONTROL TECHNICIANS

The Radiological Control Technicians are responsible for:

- Performing surveys in accordance with this plan, approved RFETS procedures, and direction provided by Radiological Engineering.
- Providing complete, accurate, and legible documentation for all surveys performed.

13.9 VENDOR FINAL SURVEY RADIOLOGICAL ENGINEERING PERSONNEL

The Radiological Engineering Personnel provided by the final survey vendor to operate the automated surface contamination monitoring system are responsible for:

- Performing surveys in accordance with this plan, approved RFETS procedures, and direction provided by Radiological Engineering.
- Providing complete, accurate, and legible final survey reports for all surveys performed.

14.0 TRAINING

Formal and informal training will be provided to Radiation Safety personnel on an as needed basis. Radiological Engineers will receive formal MARSSIM training. RCTs and RCT supervisors will receive documented on-the-job training regarding final survey instructions, isolation controls and CRSP contents. RCTs are trained on RFETS contamination, sampling, and instrument procedures. A formal training matrix has been developed, and is included in the 779 Closure Project Health and Safety Plan.

15.0 HOUSEKEEPING

Because alpha contamination is hard to detect and can be masked, the survey areas will be stripped out and thoroughly cleaned prior to the performance of final surveys.

16.0 QUALITY ASSURANCE AND QUALITY CONTROL PROGRAM

16.1 QUALITY CONTROL

Site surveys shall be performed in a manner that ensures results are accurate and sources of uncertainty are identified and controlled. Surveys performed by trained individuals will be conducted with approved written procedures and properly calibrated instruments that are sensitive to the suspected contaminant. In addition, quality control samples will be obtained to demonstrate that measurement results have the required precision and are sufficiently free of errors to accurately represent the Building 779 Cluster. If portable instruments are used exclusively, total surface contamination survey data will be evaluated in accordance with MARSSIM to assess the statistical validity of the quantity of samples obtained and the quality of the data.

A Comprehensive Quality Control Program for the SCMs will be provided to the B779 Cluster Final Survey Radiological Engineer for RFETS review and approval prior to the use of the SCMs on site.

Quality control measurements are obtained for the following instruments as follows:

AUTOMATED SURFACE CONTAMINATION MONITORS	PORTABLE INSTRUMENTATION
Periodic calibration checks are performed on the system on a daily basis to verify calibration. Duplicate measurements are performed as follows: For most measurements, a 2nd detector is utilized simultaneously with the 1st detector. The output from each detector is compared with each other to verify operability The duplicate measurements will be compared to the original values to ensure the resulting conclusions of each meet the applicable DCGL. In instances where the 2nd detector is not used, such as in small areas, two (2) passes are made with one detector and comparisons of the data are made. The duplicate measurements will be compared to the original values to ensure the resulting conclusions of each meet the applicable DCGL.	Approximately 5% of the total surface contamination measurements will be repeated as QC duplicates. The original values and the duplicate value will be compared against the applicable DCGL. If both values are less than the applicable DCGL, they will be considered acceptable. Qualified personnel separately from the initial survey will perform these independent QC surveys preferably with different instrumentation. The measurements to be repeated will be at the same locations as the initial positive values.

16.1.1 Hypothesis Testing

The null hypothesis (H_0) for the B779 Cluster is that contamination exists above the $DCGL_W$. A Type I decision error occurs when this hypothesis is rejected when it is true. A Type II decision error occurs when the null hypothesis is accepted when it is false. The probability of making a Type I error is denoted by alpha (α). The assigned value at B779 for α is 0.05, which corresponds to a 95% probability that a Type I error will not be made. The probability of making a Type II error is denoted by beta (β). The assigned value at B779 for β is 0.05, which corresponds to a 95% probability that a Type II error will not be made. The alternate hypothesis (H_a) for the B779 Cluster is that contamination does not exist above the $DCGL_W$.

16.2 DATA QUALITY INDICATORS

16.2.1 Precision

When using portable survey instrumentation, the precision of survey data will be determined by comparing the 5% duplicate QC total surface contamination measurements with the original survey measurements. Both values will be compared against the applicable DCGL. If both values are less than the applicable DCGL, they will be considered acceptable. The SIMS data from each detector from the automated surface contamination monitoring system is compared to assess the instrument's precision.

16.2.2 Bias

Sample bias will be verified not to occur in media samples by spikes performed by the laboratory performing the analyses. The laboratories QA/QC program will be the driving force for this evolution and will delineate the requirements. Instruments used for total surface and removable contamination as well as laboratory instruments used for analytical determinations are verified to be accurate by the performance of daily performance checks.

16.2.3 Accuracy

Instruments used for total surface and removable contamination as well as laboratory instruments used for analytical determinations are verified to be accurate by the performance of daily performance checks. In addition, if precision is maintained at a high level and bias is minimized, then accuracy will be high.

16.2.4 Representativeness

Representativeness of survey measurements will be assured by a careful overview of all data generated for the final survey report and by the implementation of MARSSIM methodology.

16.2.5 Comparability

Comparability of data will be assured by utilizing the same type of contamination monitoring systems for all survey measurements. For automated surface contamination monitoring systems, additional measurements are obtained as described in Section 16.0 to ensure comparability.

16.2.6 Completeness

A thorough evaluation will be performed for each survey package to ensure the prescribed number of measurements is obtained. In addition, at least 20% additional measurements will be prescribed for each survey unit as recommended by MARSSIM for the total surface measurement, removable measurement, and paint/sample media sample calculations. This will ensure an adequate number of samples are obtained even if a few data points are lost or invalidated.

16.3 SURVEY DOCUMENTATION

Records of the survey will be maintained in a survey package. The survey package will be the primary method of controlling and tracking Closeout radiological survey results. The records compiled in a survey package will include (as applicable):

- Survey Package Coversheet
- Alpha Survey Instruction Forms
- Instrument Data Sheets
- Survey Signature Page
- Total Alpha Survey Data Sheets
- Instruction For Surface Media Sampling
- Investigation Documentation Forms
- Survey Unit Diagrams/Maps
- Tennelec Printout Of Smear Survey Analyses
- Laboratory Analysis Results
- Data Analysis Summary
- Copies of Completed Chain Of Custody Forms
- Calculations to Determine the Number of Samples Required

16.4 CHAIN OF CUSTODY (COC)

Samples will be managed to ensure that there is an accurate record of sample collection, transport, analysis, and disposal. This will insure that samples are neither lost nor tampered with and that the sample analyzed is traceable to a specific location in the field. COC documentation shall be completed for all samples submitted for laboratory analysis. The COC form will be included as part of the Closeout survey documentation.

16.5 ANALYTICAL LABORATORY QUALITY ASSURANCE/QUALITY CONTROL

All samples collected for RFETS laboratories will analyze special analysis, or an approved contracted laboratory. Trained individuals using appropriate equipment and procedures will perform the analysis. The laboratory will have analytical capabilities for the radionuclides of interest (Plutonium, Americium, and Uranium) and an established QA/QC program that assures the validity of the analytical results. The laboratory analytical methods will be capable of measuring levels at or below 50% of the established release criteria. All results will state the detection limit for the analysis.

16.6 DATA ASSESSMENT

16.6.1 Data Verification

This phase ensures that the requirements stated in this closeout survey plan are implemented as prescribed. This includes inspections, QC checks, technical reviews, performance evaluations, and audits.

16.6.2 Data Validation

All survey data collected will be qualified or rejected as a result of data validation and/or verification.

16.7 DATA INTERPRETATION

16.7.1 Reporting Units

All measurements will be reported in units appropriate for comparison with DOE Order 5400.5 surface contamination limits.

16.7.1.1 Removable Activity Measurements

Measurements of removable surface activity will be converted from gross count rate to units of net dpm per 100 cm^2 by subtracting the background count rate of the smear counting detector and correcting the net count rate for detector efficiency.

16.7.1.2 Paint/Surface Media Activity Measurements

Paint/surface media sample data will be converted from pCi/gm to dpm/100 cm^2 based on the sample weight and surface area over which the sample was collected. These sample results will be compared against the average release criteria. Measurements less than the average $DCGL_W$ will be deemed acceptable. Measurements greater than the average $DCGL_W$ will indicate a need for remediation (see Appendix D for sampling methodology). Kaiser-Hill received concurrence of this methodology by the Department of Energy. In addition, it is consistent with the guidelines specified in the final MARSSIM. (See attachments 1 and 2)

16.7.1.1 Total Activity Measurements

AUTOMATED SURFACE CONTAMINATION MONITORS	PORTABLE INSTRUMENTATION
Total Surface Activity Measurements Approximately 400 measurements of total surface contamination per 1 m^2 are recorded by SCMs. These measurements are output as dpm per 100 cm^2 after correcting the count rate for detector efficiency and detector surface area. The mean, standard deviation, maximum and minimum values are calculated and recorded for each 1 m^2. Individual measurements will be compared against the average and the maximum release criteria. Measurements less than the average $DCGL_W$ will be deemed acceptable. Measurements greater than the average $DCGL_W$ but less than the maximum $DCGL_{EMC}$ will require investigation to determine if the average of measurements within 1 m^2 exceeds the average $DCGL_W$. Investigations will be performed as directed by Radiological Engineering and will demonstrate compliance with the average DCGL when averaged over a maximum of 1 m^2. **Scan Survey Activity Measurements** The process of obtaining total measurements also fulfills the requirement for scan measurements.	**Total Surface Activity Measurements** Measurements of total surface activity will be converted from observed gross counts per minute to net dpm per 100 cm^2 by subtracting the appropriate local area background count rate and correcting the net count rate for detector efficiency and detector surface area. Local area backgrounds will be prescribed in survey instructions and the appropriate background will be applied. Individual measurements will be compared against the average and the maximum release criteria. Measurements less than the average $DCGL_W$ will be deemed acceptable. Measurements greater than the average $DCGL_W$ but less than the maximum $DCGL_{EMC}$ will require investigation to determine if the average of nine measurements (including the measurement greater than the average DCGL) within a given one m^2 exceeds the average DCGL.. Investigations will be performed as directed by Radiological Engineering and will demonstrate compliance with the average DCGL when averaged over a maximum of 1 m^2. In addition, to ensure the entire square meter surface is less than the maximum DCGL, a 100% scan of the entire meter will be performed. **Scan Survey Activity Measurements** Scan measurements are obtained by slowly moving a probe, within 1/4 inch, across the surface of the area to be scanned. If elevated counts are detected, a one minute direct measurement will be obtained and will be converted from observed gross counts per minute to net dpm per 100 cm^2 by subtracting the appropriate background count rate and correcting the net count rate for detector efficiency and detector surface area. Scan surveys will be performed for the percentage required in the Radiological Instructions. However, only results that exceed RFETS limits will be recorded. The percentage scanned for each survey unit will be annotated on the applicable survey map(s).

17.0 REPORTING SURVEY FINDINGS

A Closeout Radiological Survey Report, including an executive summary, will be prepared at the conclusion of the project. In addition, Interim reports will be compiled of completed survey packages as required to support project scheduling. The reports will be prepared by the Final Survey Radiological Engineer. A summary of the following information showing that the building surfaces meet the release criteria will be provided.

- Removable Surface Alpha Activity
- Total Surface Alpha Activity
- QA Sample Results
- Paint/Surface Media Samples
- Solid Samples (if obtained)

In addition to the data above, the following statistical parameters will be calculated and compared to the applicable DCGL and reported for each m^2 for the surface contamination monitoring system surveys, and for each survey unit for portable instrumentation surveys.

- Maximum
- Mean
- Standard Deviation
- Minimum

Graphical representation of data will be provided as follows:

AUTOMATED SURFACE CONTAMINATION MONITORS	PORTABLE INSTRUMENTATION
The standard graphical output from the Survey Information Management System associated with the SCMs include numerous image and contour plots that provide the same information as posting plots and frequency plots.	A posting plot and frequency plot (histogram) will be generated for total surface activity measurements for each survey unit

18.0 REFERENCES

MARSSIM - *Multi-Agency Radiation Survey And Site Investigation Manual*, 12/97

DOE Order 5400.5 - *Radiation Protection of the Public and the Environment*

NRC Reg. Guide 1.86 - *Termination of Operating Licenses for Nuclear Reactors*

3-PRO-165-RSP-07.02, *Contamination Monitoring Requirements*

3-PRO-141-RSP-09.01, *Unrestricted Release of Property, Material, Equipment and Waste*

I-P73-HSP-18.10, *Radioactive Material Transfer And Unrestricted Release Of Property And Waste*

Reconnaissance Level Characterization Report For the Building 779 Closure Project, November 1997

Decommissioning Program Plan, November 1997

DOE, 1996, *Final Rocky Flats Cleanup Agreement*, Rocky Flats Environmental Technology Site, Golden, CO.

SCM001, *Calibration and Field Confirmatory Tests of the Incremental Encoder Included on the SCM*, 3/97

SCM007 *Response check of any PSPC Detector Configuration Installed on the SCM*, 10/97

Appendix A

Instrumentation

INSTRUMENTATION

Instrument	Count Type	Allowable Bkgd Counts	Acceptable Application	Typical MDA for total alpha activity measurements (dpm/100 cm^2)	Maximum Acceptable Scan Rate (in/sec)
NE Electra w/ DP6 Probe	60 sec.	2	Direct Alpha Surveys (Total Activity)	37	1/2 in./sec.
Tennelec Low Level Alpha Beta System	2 min. (alpha)	0.5	Removable Alpha Swipes	10	N/A

Portable Instruments

The above instrumentation parameters including maximum acceptable scan rate are based on the following:

- Current RFETS operating procedures
- The NE Electra used to perform alpha scans provides the ability to detect the following: 1) a single count at a ½ inch/second scan rate > 50% of the time, and 2) a 2nd count within a reasonable period of time (6 seconds), 90% of the time at the alpha $DCGL_W$ of 100 dpm/100 cm^2. In addition, the scan MDC of the NE Electra at 1½ in./sec. is less then the applicable $DCGL_{EMC}$ for alpha in accordance with Technical basis document and applicable addendum, *Methods to Demonstrate Compliance with Performance Requirements for Swipe Counting and Portable Contamination Survey Instrumentation used to Evaluate Property and Waste for Unrestricted Waste, 6/7/1995*
- Scan rate calculations performed in accordance with MDC scan formula from MARSSIM, Section 6.7.2.2

Laboratory Instrumentation

Typical laboratory instrument is used for on-site analysis and includes but is not limited to alpha spectroscopy systems, gamma spectroscopy systems, low background alpha/beta gas flow proportioned systems and liquid scintillation counting systems. MDAs are determined on an individual basis for each sample to be analyzed. Adequate sample volume will be obtained to ensure MDAs of approximately 50% of the applicable DCGLs are obtained for all final survey data. Analysis of solid samples for material to be released in accordance with the No-Rad-Added program will be required to achieve an MDA of 50% of the applicable background value as delineated in 3-PRO-140-RSP-09.03, *Unrestricted Release of Bulk or Volume Material.*

Other Instrumentation

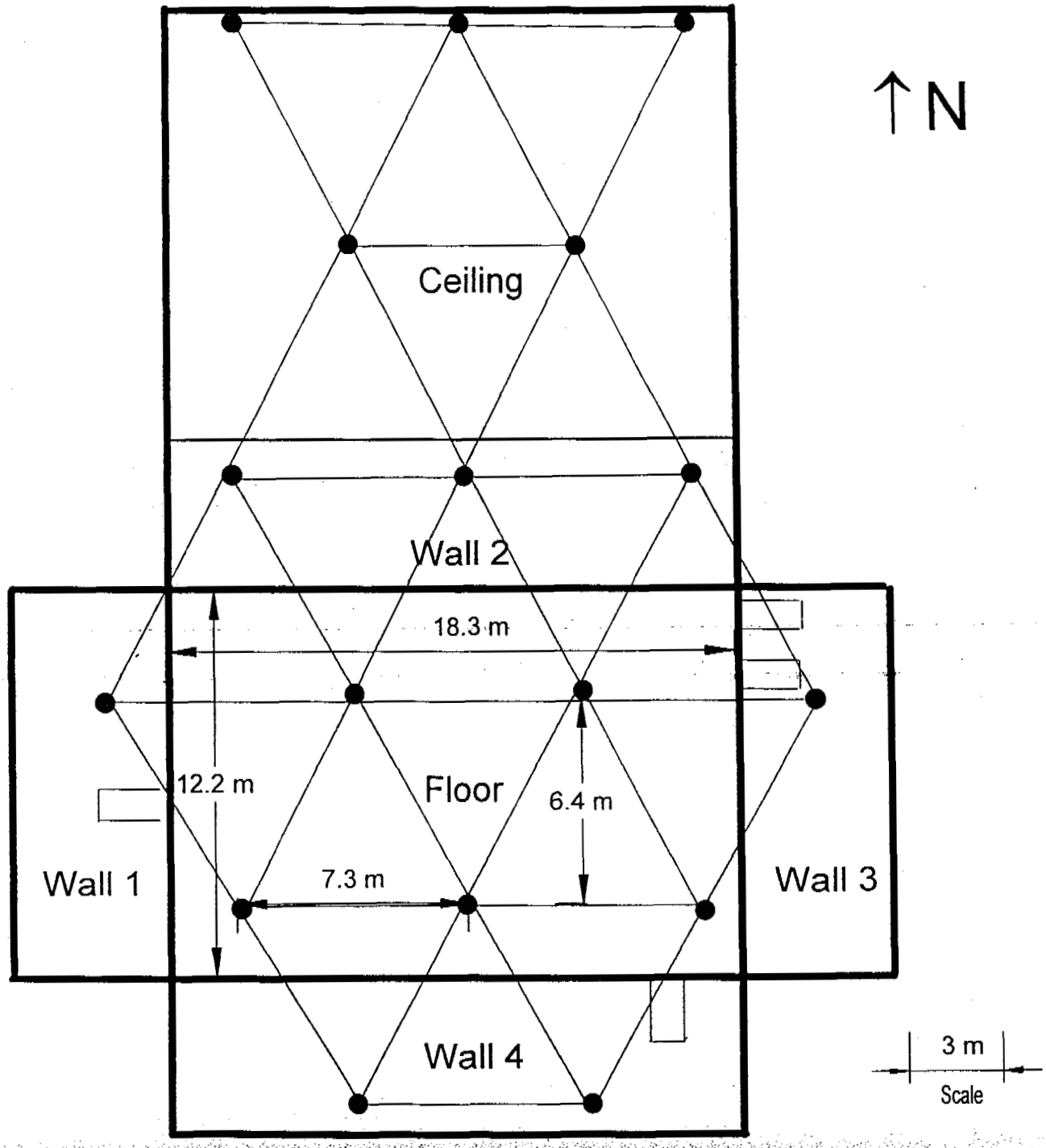
SCMs may be utilized for portions of the final survey. MDAs for the systems are determined on an individual basis at the time the survey measurements are obtained. Other site-approved instrumentation may be utilized as required by Radiological Engineering. Surface media/paint sample MDAs after converting to dpm/100 cm^2 will be verified to be approximately 50% of the applicable DCGLs for all final survey data obtained with this instrumentation. Independent Verifications will be performed with equivalent instrumentation.

Appendix B

Typical Grid Map

Survey Area: A	**Survey Unit:** 001	**Building:** 729	
Survey Unit Description : Bldg. 729 plenum area			
Classification: 2	**Floor m^2:** 223	**Total m^2:** 850	**Grid Size:** 7.3m. x 6.4m

RCT Printed Name	Employee #	RCT Signature	Date



(#) - Survey Measurement Location
LAB - Local Area Background Location
Scan Survey Location
Paint/Surface/Solid Media Sample

Appendix C

Building/Room Historical Radiological Survey Data

Building/Room Historical Radiological Survey Data

Room No.	Process Information	Characterization Survey Data (dpm/100 cm^2)
001	This sub-basement contained the process piping for the T-5 tank, which was the holding tank for all B779 process drains. This tank was flushed and triple-rinsed.	All measurements < MDA
100	Entrance	No survey data
101A	Foyer	No survey data
103	Men's Locker room	No survey data
103A	Men's Restroom	No survey data
103B	Shower	No survey data
104	Elevator	No survey data
105	Hallway	No survey data
106	Office	No survey data
107	Office	No survey data
108	Office	No survey data
109	Office	No survey data
110	Office	No survey data
110A	Office	No survey data
111	Office	No survey data
113	Assembly Technology Machine Shop	No survey data
114	Office/Storage	No survey data
115	Office/Break Area	No survey data
115A	Storage	No survey data
116	Hallway	No survey data
116A	Equipment Room	No survey data
117	Storage	No survey data
118	Airlock	No survey data
119	Hallway	No survey data
120	Old Change Room	No survey data
121	Maintenance Shop	All measurements < MDA
121A	Office	All measurements < MDA
121B	Office	All measurements < MDA
122	Control Room	No survey data
123	This was the decontamination room and likely has contamination in the process drains leading from it.	No survey data
124	This was an Radiation Control Technician (RCA) office.	No survey data
125	This room was an RCA office. Radiation sources were stored in the northeast corner of the room.	No survey data

Room No.	Process Information	Characterization Survey Data (dpm/100 cm^2)
126	This was a utility area and should not contain appreciable amounts of Pu other than what might be in process piping. There were glove boxes for house vacuum and batteries for uninterrupted emergency power supply. In Room 126, there was a helium tank system and scrubber on the west wall for a helium inerted glove-box in Room 133. It was abandoned in the late 1970s or early 1980s. The system never went hot. The room above the T-5 tank housed pumps and two cooling water system tanks. There were two other pits in addition to the one containing the T-5 tank that were accessed from the pump room. These pits are contaminated.	All measurements < MDA
127	This was a utility room containing chillers and part of the building's original ventilation system. The filter plenum was contaminated.	All measurements < MDA
128	This room was used for repair of radiation instruments. Radiation sources were stored in this room.	No survey data
129	Stairwell	No survey data
130	Janitor Closet	Up to 81 removable
131	This was an aqueous laboratory supporting pyrochemical technology.	Up to 540
132	Source Check Lab	No survey data
133	Residue Storage	Up to 480
134	Flammable Storage	All measurements < MDA
135	Supply Storage	All measurements < MDA
136	Chemical Technician Office	All measurements < MDA
137	Residue Recovery Extraction	Up to 600,000
138	Chemical Storage	All measurements < MDA
139	Ferrite Actinide Removal	Up to 13,200
140	Metal Preparation Laboratory	Up to 2400
140A	Scanning Electron Support Room	All measurements < MDA
140B	Scanning Electron Microscope (SEM)	All measurements < MDA
141	ESCA for non-radioactive analysis	Up to 180
141A	Metallurgy Laboratory, Salt Crete Analysis	All measurements < MDA
141B	This room had a scanning electron microscope.	All measurements < MDA
141C	This room contained an metallograph and optical reduction equipment. This equipment was used to photograph samples.	All measurements < MDA
142	This was a utility room which contained part of the building's original ventilation system. This room was used as a RCRA storage unit for waste oil.	No survey data
143	Airlock to Annex	No survey data
144	Elevator	No survey data
145	Office Area	All measurements < MDA
146	Office Area	All measurements < MDA
147	This room was used for drum storage for radiological waste. It also supported Room 150 with nuclear joining.	No survey data

Room No.	Process Information	Characterization Survey Data (dpm/100 cm^2)
148	Airlock	No survey data
149	Hallway	No survey data
149	Hallway	No survey data
150	This room was used for nuclear joining of metal weapon components and for supercritical CO^2 cleaning. Cleaning and rinsing components was performed prior to the welding operation. the process involved torch brazing.	All measurements < MDA
151	Office	All measurements < MDA
152	Room 152 was used as an experimental casting lab to test metal compatibility with graphite mold substrates. Pu and non-nuclear metals were heated until molten and poured into graphite molds. The molds were then examined and analyzed.	Up to 8502
153	This room was used for radiological waste drum storage and contained a trash compactor.	Up to 180
153A	This room had a compactor for hot waste, a lead drum shield, two bottles, and three abandoned pumps. This room appears to have been used for drum storage at one time.	Up to 10,000
153B	This room had a downdraft table used to repackage waste. The room is posted as respiratory protection required.	Up to 9600
154	This room was used for hydriding and dehydriding Pu from substrates. Glove boxes 1363 and 1364 is where hydrating/dehydrating was accomplished.	Up to 1500
155	This room was Pu sample-mounting laboratory support auger spectroscopy. It had etching, polishing, a furnace, and B-boxes to pull samples out of line.	Up to 3360
156	This room was the calorimeter room.	All measurements < MDA
157	Tensile testing lab	Up to 4920
158	Storage	No survey data
159	This was a permitted storage area for RCRA waste (Unit 779-90.42). There were several drums stored here containing mixed residues.	No survey data
160A	Room 160A was a vault that contained Special Nuclear Material (SNM). SNM was removed from this vault in 1996.	Up to 5400
160	This room was retrofitted in the early 1980s as a pyrochemical development facility. Operations that took place in this room included DOR, ER, Salt Scrub, and other high temperature studies with Pu and Am. In 1985, there was a major stationary furnace breach in glove-box 865 that contaminated the entire room with Pu and Am. Smears taken immediately after measured infinity. It took an entire year to completely decontaminate the room. Walls, floors, ceiling and pipes were painted after decontaminating the room to fix the remaining contamination. There was reported contamination in the room's ventilation system. This contamination may have migrated to adjacent rooms.	Up to 1230
161	Janitor Closet	No survey data
162	Machine Shop	All measurements < MDA
163	This room was used for empty drum storage.	No survey data
163A	Office	No survey data
164	Hallway (Airlock)	No survey data

Room No.	Process Information	Characterization Survey Data (dpm/100 cm^2)
165	Double Doors	No survey data
166	Airlock	No survey data
167	Women's Locker Room	No survey data
170	Dumbwaiter	All measurements < MDA
171	This room contained SNM storage vaults and had Benelex-shielded cubicles.	All measurements < MDA
172	A chain-veyor vault is located in Room 172.	All measurements < MDA
173	Utility Area, Mechanical Room	All measurements < MDA
201	Office	No survey data
201A	Office	No survey data
201B	Office	No survey data
202	Office	All measurements < MDA
202A	Office.	All measurements < MDA
203	Office	All measurements < MDA
204	Office	All measurements < MDA
204A	Office	All measurements < MDA
204B	Office	All measurements < MDA
205	Office	All measurements < MDA
206	Office	No survey data
207	Office	All measurements < MDA
207A	Office	All measurements < MDA
207B	Office	No survey data
207C	Office	No survey data
208	Office	No survey data
209	Office	No survey data
210A	Office	All measurements < MDA
211	Office	No survey data
212	Office	No survey data
212A	Office	All measurements < MDA
213	Office	No survey data
214	Office	No survey data
215	Hallway (Airlock)	No survey data
216	Hallway	No survey data
217	Room 217 was a part of Product Physical Chemistry that performed research and development studies for production support, product material surveillance, material research, and material compatibility studies.	Up to 270
218	Room 218 was a part of Product Physical Chemistry that performed research and development studies for production support, product material surveillance, material research, & material compatibility studies.	Up to 3840
219	Restroom	All measurements < MDA
220	Metallurgy Laboratory Polymer Preparation Plutonium reaction studies.	Up to 13,200

Room No.	Process Information	Characterization Survey Data (dpm/100 cm^2)
221	Gas bottle storage	All measurements < MDA
221A	Office	All measurements < MDA
221B	There was a drum liner stored here with total surface contamination. There was also laboratory jack that has total surface contamination. There was an uncontaminated vacuum system also present.	All measurements < MDA
221C	Office	All measurements < MDA
222	Room 222 was a part of Product Physical Chemistry that performed research and development studies for production support, product material surveillance, material research, and material compatibility studies.	Up to 37,230
222A	Storage Room	All measurements < MDA
223	Room 223 was a coatings laboratory that coated U, Be, stainless steel, and aluminum parts with a thin layer of metal. The basic process equipment consisted of a vacuum chamber, arc welder, vacuum pump, and associated water cooling equipment.	Up to 720
224	Decontamination Room	All measurements < MDA
225	Room 225 was a coatings laboratory that coated U, Be, stainless steel, and aluminum parts with a thin layer of metal. The basic process equipment consisted of a vacuum chamber, arc welder, vacuum pump, and associated water-cooling equipment.	Up to 1728
226	Stairway	
228	This room was used for sample preparation for X-ray analysis, Pu metallurgy, and tensile testing.	Up to 34,080
229	Office	All measurements < MDA
230	Office	All measurements < MDA
231	Office	All measurements < MDA
232	Office	All measurements < MDA
233	Office	All measurements < MDA
234	Room 234 was a part of the Pu physical metallurgy research and development group which prepared, analyzed, and collected various metallurgical samples.	Up to 2400
234A	Total surface contamination under paint.	Up to 18,000
234B	Previous darkroom	Up to 240
235	This room had a contaminated transmission electron microscope.	All measurements < MDA
236	Airlock and Bridge to B777	No survey data
237	Hall to Annex	No survey data
270	Room 270 was a part of Product Physical Chemistry, which performed research and development, studies for production support, product material surveillance, material research, and material compatibility studies.	All measurements < MDA
271	Room 271 had low-level mixed waste storage cabinets for treatability studies where the Polymer Development Team was storing samples. These are also were used for storage of archived low-level mixed waste samples.	All measurements < MDA
272	This was a testing laboratory.	Up to 1300
273	Misc.	All measurements < MDA

Room No.	Process Information	Characterization Survey Data (dpm/100 cm^2)
274	Equipment Storage/Office	All measurements < MDA
275	Equipment Storage/Office	All measurements < MDA
277	Equipment Storage/Office	All measurements < MDA
B779 Exterior	Exterior walls	No survey data
B779 Exterior	Roof	No survey data
B727	Building 727 housed a 500 kilowatt generator which provided emergency power to Building 782. The building is approximately 380 sq. ft. and is constructed of concrete block and reinforced concrete.	No survey data
B727	Exterior Walls	No survey data
B727	Roof	No survey data
B729 Plenum Area	This one-story concrete block plenum building is approximately 3,000 ft^2 with a small penthouse on the roof. This building is located south of Building 779 and provided zone 1 and room air ventilation to the storage vaults and the rooms directly above the storage vaults on the south side of Building 779. An overhead tunnel containing exhaust ductwork connects buildings 779 and 729. Building 729 contains two filter banks, a four-stage glove box plenum and a two-stage room air plenum. There are two pits beneath the plenums to collect fire sprinkler wastewater.	All measurements < MDA
B729	Control room, Airlock, Hallway, & Diesel Generator Room	All measurements < MDA
B729 Exterior	Roof	No survey data
B729 Exterior	Exterior walls	No survey data
B780	Building 780 is a corrugated metal shed attached to the northeast corner of Building 779. It was used to store paint, solvents, miscellaneous equipment, and other material. Interior and exterior walls.	No survey data
B780	Roof	No survey data
B780A/B	Building 780A is another storage facility located east of Building 779 that is constructed of corrugated steel. Interior and exterior walls and roof.	No survey data
B780A/B	Roof	No survey data
B782 Interior	This plenum building is approximately 6,200 ft^2 and is a one-story pre-cast, reinforced concrete building. It is located east of Building 779 and provided Zone 1 and room air ventilation to the rest of Building 779, Buildings 779 and 782 are connected by an underground tunnel containing exhaust ductwork. Building 782 contains three exhaust plenums for Buildings 779 and 782, and a supply plenum for Building 782.	All measurements < MDA
B782 Exterior	Walls	No survey data
B782 Exterior	Roof	No survey data
B783	Constructed of aluminum, steel, and reinforced concrete.	No survey data

Appendix D

Surface Media Sampling

for

Transuranic Alpha Contamination

SURFACE MEDIA SAMPLING FOR TRANSURANIC ALPHA CONTAMINATION

- At the locations designated by Radiological Engineering, a 12" by 12" sample area is marked (or a suitable sized sample area as specified by radiological engineering).
- A total surface contamination and removable contamination survey for alpha is obtained.
- A plastic bag or equivalent is affixed beneath the sample location to collect the sample media.
- An appropriate tool is used to obtain a sample by removing the surface material to a depth of 1/16 to 1/8 of an inch over the entire sample surface area.
- A post total surface contamination and removable contamination survey for alpha on the sample area is obtained.
- The sample media is weighed, transferred to a labeled sample container and the required chain of custody documentation is completed.
- The sampling tool is wiped down and surveyed to remove loose sample media and prevent possible sample cross-contamination.
- The above steps are repeated at each designated sample location.

SURFACE MEDIA SAMPLE RESULTS vs SURFACE RELEASE CRITERIA

pCi activity in a 12" x 12" surface media sample is converted to 100 dpm/100 cm^2 (which is the average transuranic alpha surface contamination limit from DOE order 5400.5) as follows:

Equivalent pCi transuranic alpha activity = (100 dpm/ 100 cm^2 X 928.8 cm^2) / (2.22 dpm/pCi * 100)

The total equivalent bulk transuranic alpha activity for a 12" by 12" sample is equal to 418.4 pCi

Where:

- 100 dpm/ 100 cm^2 is the average transuranic alpha surface contamination limit
- 928.8 cm^2 is the 12" X 12" surface area of the sample
- 2.22 is the activity conversion from dpm to pCi
- 100 converts from 100 cm^2 to cm^2

Since typically laboratory results are reported in pCi/gm, and this is the total activity of the sample, the mass of the sample must be known and the pCi/gm value multiplied by the total sample mass.

For example:

If the laboratory result is 5 pCi/gm transuranic alpha, and the total samples mass was 100 gms, the total activity is 500 pCi and the result exceeds the total equivalent bulk activity limit of 418.4 pCi (transuranic surface contamination limit of 100 dpm/100 cm^2) and additional sampling would be required.

The actual average total surface activity is calculated as follows:

Total Surface Activity (TSA) (in dpm/ 100 cm^2) = [Sample weight (grams) X Sample Results (pCi/gm) X 2.22 dpm/pCi] / [Sample Area (cm^2)]

TSA = (100 gms X 5.0 pCi/gm X 2.22 dpm/pCi) X 100 / (928.8 cm^2) = 119.5 dpm/100 cm^2

Appendix E

Radiological Survey Package Information

SURVEY PACKAGE COVER SHEET

Survey Area: A	**Survey Unit:** 001	**Building:** 729

Survey Unit Description

Bldg 729 plenum area

Justification for Survey Unit Classification

Classification: Class 1 ☐ Class 2 ☐ Class 3 ☐

No history of radioactive material exists outside of the glove box and building plenums based on radiological characterization data obtained. However, high levels of alpha contamination existed in the pre-filter portions of the plenums, as well as the inlet vent piping to the plenums. All radioactively contaminated structures and systems have been removed.

Special Support Requirements

Scaffolding will be required to access upper walls and ceiling. Auxiliary lighting may be required.

Special Safety Precautions

Fall protection is required for work above 6 ft.

Isolation Controls

Level 1 ☐ Level 2 ☐

No use, storage or movement of radioactive material with the exception of instrument check sources is permitted in this survey unit. Prior to the final survey of this survey unit, training sessions will be held with building personnel regarding isolation controls.

Final configuration of this area is to be maintained. Authorization shall be obtained prior to the removal of components from this area.

Grid Requirements

Gridding is to be performed as indicated on the survey unit map(s). Total and removable measurements as well as solid media samples will be labeled at each survey location. Scan surveys less than 100% will be annotated as clouds on the survey map(s).

Survey Package Implementation

Survey package ready for implementation.

Radiological Engineer Printed Name	Employee #	Radiological Engineer Signature	Date

Survey Package Closure

All required reviews are complete, and data analysis results meet acceptance criteria. Survey package is authorized for closure.

Radiological Engineer Printed Name	Employee #	Radiological Engineer Signature	Date
Radiological Safety Authority Printed Name	**Employee #**	**Radiological Safety Authority Signature**	**Date**

EXAMPLE

ALPHA SURVEY INSTRUCTIONS

Survey Area: A	**Survey Unit:** 001	**Building:** 729

Survey Unit Description: **Bldg 729 plenum area**

Prepared by:

Radiological Engineer Printed Name	Employee #	Radiological Engineer Signature	Date

Reviewed by:

Radiological Engineer Printed Name	Employee #	Radiological Engineer Signature	Date

General Instructions

1. Number floor, wall, and ceiling sample locations on applicable survey map(s) (The sample location shall be at each grid intersection.)
2. Label the measurement locations on building surfaces(LABs, total, removable, and surface media)
3. Obtain and record three (3) local area alpha background readings on the instrument data sheet for each portable instrument to be used. These local area background (LAB) readings should be obtained in the general area of the survey unit to account for background fluctuations as a result of radon variations. Annotate the LAB locations on the survey map(s).
4. Calculate and record the average local area alpha background reading on the instrument data sheet for each portable instrument to be used.
5. Obtain total and removable alpha measurements. For total activity, record actual numeric results above and below MDA for the specified survey locations. For removable activity, attach a copy of the Tennelec printout to the survey package.
6. Perform an alpha scan survey at a maximum scan rate of 2 inches per second on 100% of the total interior and exterior surface areas, at locations with the highest potential for contamination. (e.g., high traffic areas, horizontal surfaces etc.)
7. Record the scan locations as "clouds" on the survey map(s) provided.
8. In the event any alpha measurement exceeds 20 dpm/100 cm^2 removable or 100 dpm/100 cm^2 total, annotate the location on the survey map, label the building surface, record the elevated reading on the survey form, and obtain eight (8) additional total and removable measurements covering a 1 m^2 surface adjacent to the elevated measurement. Complete an Investigation Documentation Form and attach to the survey data sheet(s).
9. If any total alpha measurement exceeds 100 dpm/100 cm^2 average, or 300 dpm/100 cm^2 maximum, remediation will be required. Contact Radiological Engineering to establish a 3 meter by 3 meter investigation survey unit. After remediation, perform a 100% scan survey of the investigation survey unit. In addition, perform 1 total and 1 removable alpha measurement for each m^2 (9 measurements) and complete an Investigation Documentation Form.
10. If unable to obtain measurements at designated grid locations, mark "N/A" in the appropriate blocks, and state the reason in the comment section, then obtain additional measurements at alternate locations and note in the comments the alternate locations.
11. Modify maps/drawings, as necessary to reflect the location of doors, windows, columns etc.

Surveys to be performed in accordance with:
3-PRO-165-RSP-07.02, Contamination Monitoring Requirements.

Material and equipment to be released in accordance with:
3-PRO-141-RSP-09.01, Unrestricted Release of Property, Material, Equipment, and Waste
1-P73-HSP-18.10, Radioactive Material Transfer and Unrestricted Release of Property and Waste

INSTRUMENT DATA SHEET
Removable Contamination Survey Instrument Data

Survey Area: A	**Survey Unit:** 001	**Building:** 729

Survey Unit Description: Bldg 729 plenum area

Manufacturer	Tennelec	Tennelec	
Model	5100W		
Serial #			
Cal. Due Date			
Alpha Bkgd.			
Alpha Eff.			
Calculated MDA (Max. = 10 dpm/100 cm^2)			

Calculated MDA = CF x [2.71 + {3.29 x SQRT(bkgd x ct (1 + ts/tb))}]

Total Contamination Survey Instrument Data

Manufacturer	N.E. Tech	N.E. Tech.	N.E. Tech.	N.E. Tech.	N.E. Tech.
Model	Electra	Electra	Electra	Electra	Electra
Serial #					
Cal. Due Date					
Date					
1st Local Area Alpha Bkgd.					
2nd Local Area Alpha Bkgd.					
3rd Local Area Alpha Bkgd.					
Average Area Alpha Bkgd.					
Alpha Efficiency					
Calculated MDA (Max. = 50 dpm/100 cm^2)					
Manufacturer	N.E. Tech	N.E. Tech.	N.E. Tech.	N.E. Tech.	N.E. Tech.
Model	Electra	Electra	Electra	Electra	Electra
Serial #					
Cal. Due Date					
Date					
1st Local Area Alpha Bkgd.					
2nd Local Area Alpha Bkgd.					
3rd Local Area Alpha Bkgd.					
Average Area Alpha Bkgd.					
Alpha Efficiency					
Calculated MDA (Max. = 50 dpm/100 cm^2)					

Calculated MDA = CF x [2.71 + {4.65 x SQRT(bkgd)}]

EXAMPLE

SURVEY SIGNATURE PAGE

Survey Performed By

Survey Area: A	**Survey Unit:** 001	**Building:** 729
Survey Unit Description : Bldg 729 plenum area		

RCT Printed Name	Employee #	RCT Signature	Date
RCT Printed Name	Employee #	RCT Signature	Date
RCT Printed Name	Employee #	RCT Signature	Date
RCT Printed Name	Employee #	RCT Signature	Date
RCT Printed Name	Employee #	RCT Signature	Date
RCT Printed Name	Employee #	RCT Signature	Date
RCT Printed Name	Employee #	RCT Signature	Date
RCT Printed Name	Employee #	RCT Signature	Date
RCT Printed Name	Employee #	RCT Signature	Date

Survey Reviewed By

RCT Supervisor Printed Name	Employee #	RCT Supervisor Signature	Date

TOTAL ALPHA SURVEY DATA SHEET

Survey Area: A | **Survey Unit:** 001 | **Building:** 729

Survey Unit Description: Bldg 729 plenum area

Sample Number	Location/ Description	Special Instructions	Instrument Serial Number	Total Alpha Activity (cpm)	Total Alpha Activity (dpm/100 cm^2)	Alpha Scan Activity if > 100 dpm/100 cm^2
1	Floor	Survey accessible areas				
2	Floor	Survey accessible areas				
3	Floor	Survey accessible areas				
4	Floor	Survey accessible areas				
5	Floor	Survey accessible areas				
6	Floor	Survey accessible areas				
7	Floor	Survey accessible areas				
8	Floor	Survey accessible areas				
9	Floor	Survey accessible areas				
10	Floor	Survey accessible areas				
11	Floor	Survey accessible areas				
12	Floor	Survey accessible areas				
13	Floor	Survey accessible areas				
14	Floor	Survey accessible areas				
15	Floor	Survey accessible areas				
16	Floor	Survey accessible areas				
17	Floor	Survey accessible areas				
18	Floor	Survey accessible areas				
19	Floor	Survey accessible areas				
20	Floor	Survey accessible areas				
21	Floor	Survey accessible areas				
22	Floor	Survey accessible areas				
23	Floor	Survey accessible areas				
24	Floor	Survey accessible areas				
25	Floor	Survey accessible areas				
26	Floor	Survey accessible areas				
27	Floor	Survey accessible areas				
28	Floor	Survey accessible areas				
29	Floor	Survey accessible areas				
30	Floor	Survey accessible areas				
31	Floor	Survey accessible areas				
32	Floor	Survey accessible areas				
33	Floor	Survey accessible areas				
34	Floor	Survey accessible areas				
35	Floor	Survey accessible areas				
36	Floor	Survey accessible areas				
37	Floor	Survey accessible areas				
38	Floor	Survey accessible areas				
39	Floor	Survey accessible areas				
40	Floor	Survey accessible areas				
41	Floor	Survey accessible areas				
42	Floor	Survey accessible areas				
43	Floor	Survey accessible areas				
44	Floor	Survey accessible areas				
45	Floor	Survey accessible areas				
46	Floor	Survey accessible areas				
47	Floor	Survey accessible areas				
48	Floor	Survey accessible areas				
49	Floor	Survey accessible areas				
50	Floor	Survey accessible areas				

EXAMPLE

INSTRUCTIONS FOR SURFACE MEDIA

SAMPLING FOR TRANSURANIC ALPHA CONTAMINATION

Survey Area: A	**Survey Unit:** 001	**Building:** 729
Survey Unit Description : Bldg 729 plenum area		

Sampling Instructions

- At the locations designated by Radiological Engineering, mark a 12" by 12" sample area (or a suitable sized sample area as specified by radiological engineering).
- Perform a total and removable survey for alpha on the area marked.
- Affix a plastic bag or equivalent beneath the sample location to collect the sample media.
- Use an appropriate tool to obtain a sample by removing the surface material to a depth sufficient to expose the base material over the entire sample surface area.
- Label the sample container and location.
- Perform a post total and removable survey for alpha on the sample area.
- Wipe the sampling tool down to remove loose sample media and prevent possible sample cross-contamination.
- Repeat the above steps at each designated sample location.
- Record the sample numbers and complete the chain of custody form (COC).
- Complete and attach this sampling form and a copy of the COC to the Radiological Survey Form and forward to the final survey radiological engineer
- Forward the sample(s) to Building 559 for rad screening and laboratory disposition.

Sample #	Location	Sample Surface Area (in^2)	Remarks

Sampling Performed By

RCT Printed Name	Employee #	RCT Signature	Date

EXAMPLE

INVESTIGATION DOCUMENTATION FORM

Survey Area: A	**Survey Unit:** 001	**Building:** 729
Survey Unit Description: Bldg 729 plenum area		

Location of Area to be Investigated

Grid number(s) or location: _____

Type of elevated contamination: Removable Alpha ☐ Total Alpha ☐

Highest alpha contamination value: _____ dpm/100 cm^2

(If removable alpha is > 20 dpm/100 cm^2, the average total alpha for any m^2 is > 100 dpm/100 cm^2, or the maximum total alpha for any m^2 is >300 dpm/100 cm^2, remediation is mandatory)

Remediation

Type of remediation performed (if required): _____

Initial Survey/Re-Survey Results

Attach a map showing initial contamination measurement(s), and re-survey measurements. Record these measurements below.

Smears

1. (dpm/100 cm^2)	2. (dpm/100 cm^2)	3. (dpm/100 cm^2)	4. (dpm/100 cm^2)	5. (dpm/100 cm^2)	6. (dpm/100 cm^2)	7. (dpm/100 cm^2)	8. (dpm/100 cm^2)	9. (dpm/100 cm^2)

Total Measurements

1.(Initial) (dpm/100 cm^2)	2. (dpm/100 cm^2)	3. (dpm/100 cm^2)	4. (dpm/100 cm^2)	5. (dpm/100 cm^2)	6. (dpm/100 cm^2)	7. (dpm/100 cm^2)	8. (dpm/100 cm^2)	9. (dpm/100 cm^2)	*Mean* (If averaging[2]) (dpm/100 cm^2)

Note 1 Record the initial measurement if averaging the values to comply with the 100 dpm/100 cm^2 DOE Order 5400.5 average requirement.

Note 2 The mean of the nine measurements is required only if averaging the values to comply with the 100 dpm/100 cm^2 DOE Order 5400.5 average requirement.

Final Disposition

☐ No remediation was required.

☐ Area has been remediated successfully.

☐ Area requires additional remediation – complete additional investigation forms as necessary and N/A the following signatures if additional remediation is required.

Investigation Documentation Closure

Data analysis results meet acceptance criteria, isolation controls as previously established have been re-instituted, and this investigation is authorized for closure.

Radiological Engineer Printed Name	Employee #	Radiological Engineer Signature	Date
Radiological Safety Authority Printed Name	Employee #	Radiological Safety Authority Signature	Date

EXAMPLE